# ENGLISH AVENUE YELLOW JACKETS

2022 DESIGN CHALLENGE - RETROFIT HOUSING

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

Georgia Tech

ENGLISH AVENUE YELLOW JACKETS

# TEAM

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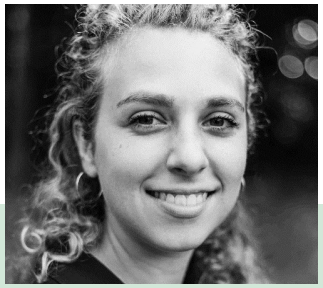

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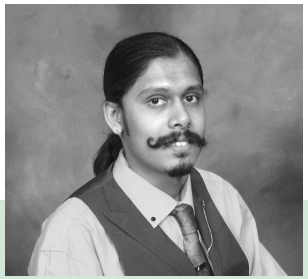

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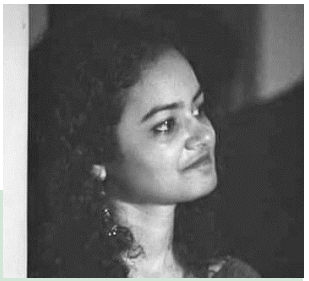

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Westside Future Fund

**Design Partner**

Perkins&Will

**Industry Partner**

# ROADMAP

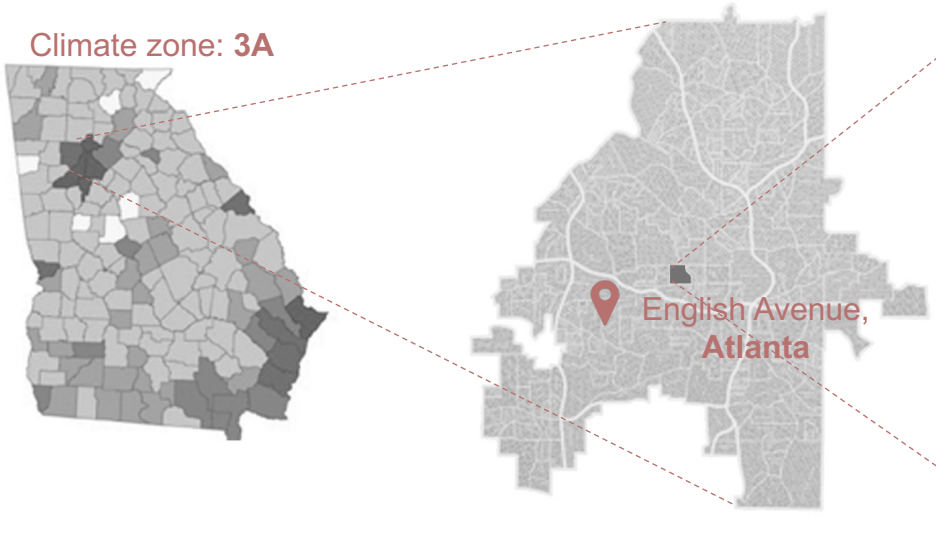
CONTEXT

DESIGN CHALLENGE

APPROACH

OUTCOME

# CONTEXT



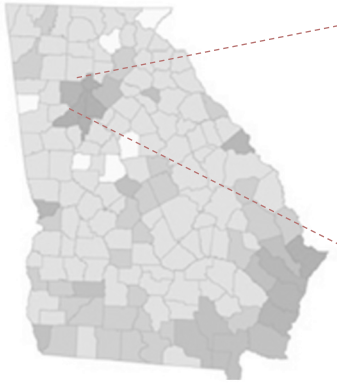


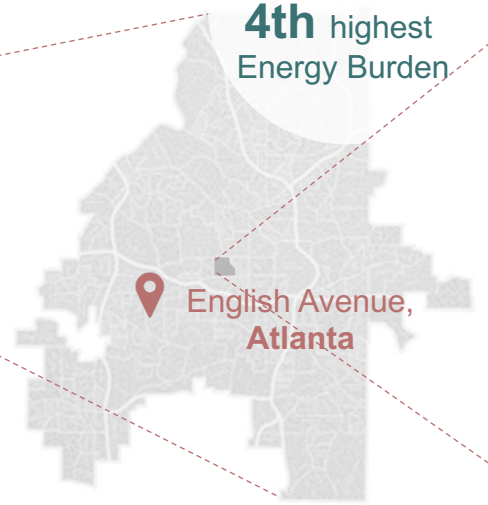
- Restoration
- Potential infill sites
- **Project site**

# CONTEXT

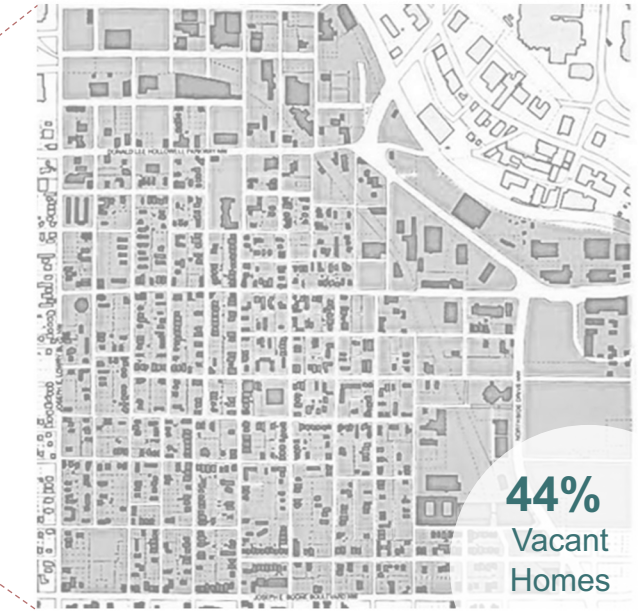
ENGLISH AVENUE YELLOW JACKETS

Climate zone: **3A**






**4th** highest Energy Burden



**44%** Vacant Homes

22.8% Below poverty line

81% working age group

78% Non-family households

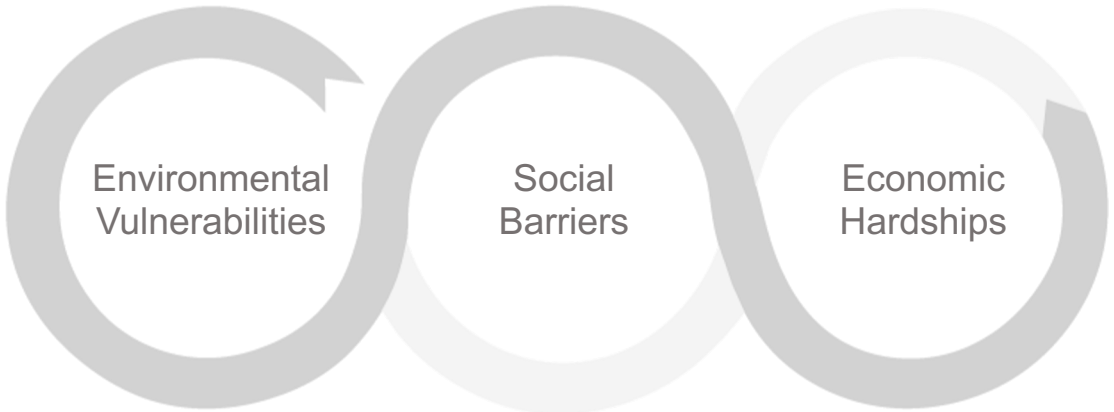
60.53% housing burdened

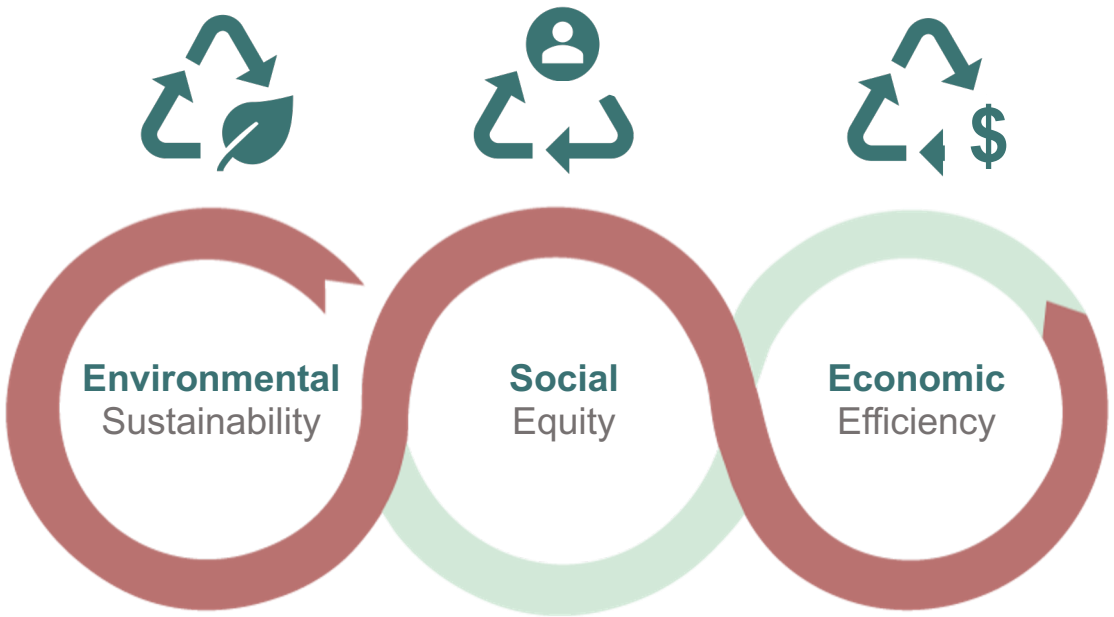
"Anybody can build a new house, everybody can't do renovation."

**Resident views**

"English Avenue is diverse. We have single women, young women, veterans, senior citizens..."

# CHALLENGES


Environmental Vulnerabilities
Social Barriers
Economic Hardships




The **Triple Bottom Line**

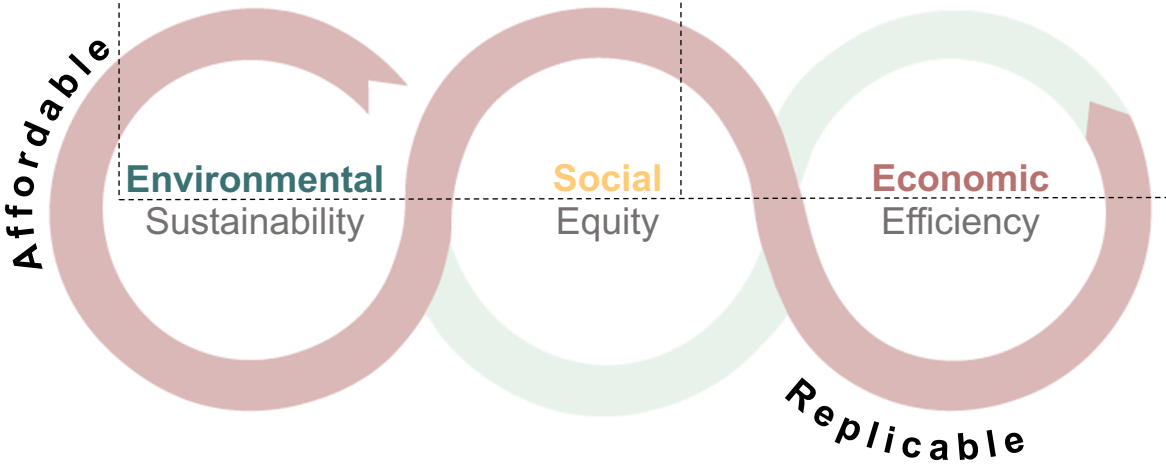
ENGLISH AVENUE YELLOW JACKETS

## RETROFITTING TO NET-POSITIVE HOME

- Low EE, GWP, and ODP Materials
- Integrated Solutions
- Passive Design Strategies

## PARTICIPATORY DESIGN

- Preserving vernacular elements
- Superior indoor environment
- Engaging-outdoor atmosphere




## HOMEOWNERSHIP AND UPWARD MOBILITY

- Repositioning local funds
- Wealth creation
- Higher investment in MEP system

# FAMILY STRUCTURES

## Single mother with children

- Sonja (31)
- Registered Nurse
- Makes **$58,000 (75% AMI)** a year
- Struggled to find a house she could afford

**33%**

## Parents with one child

- Ray (28) and Tamika (26)
- Ray is a firefighter
- Tamika is a schoolteacher
- A household income of **$114,000 (147% AMI)**
- Tamika is still paying off the last of her student loan debt

**21%**

## Single person

- Kofi (22)
- Recently graduated from college
- Makes **$50,000 (83% AMI)**
- By converting one of the bedrooms into an office, she can work.

**45%**

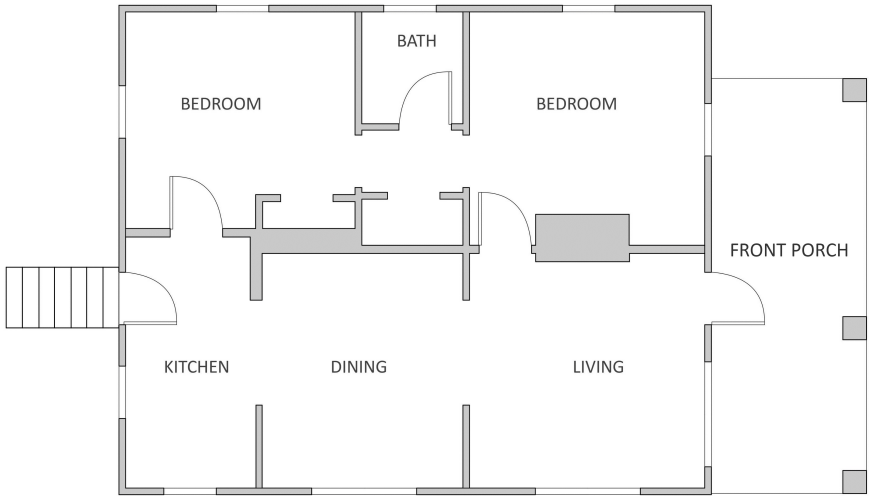
**"Affordable homes fo aging families"**

**"Healthy indoor Environment"**

**"Low Utility bills for all"**

# EXISTING CONDITION


EXISTING HOUSE – STREET VIEW




EXISTING LAYOUT

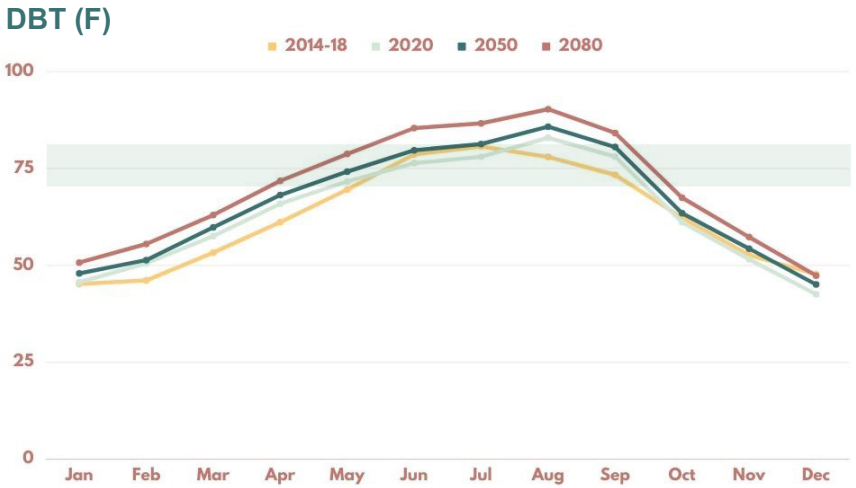

Lack of thermal barrier

EXISTING CONDITION OF THE HOUSE

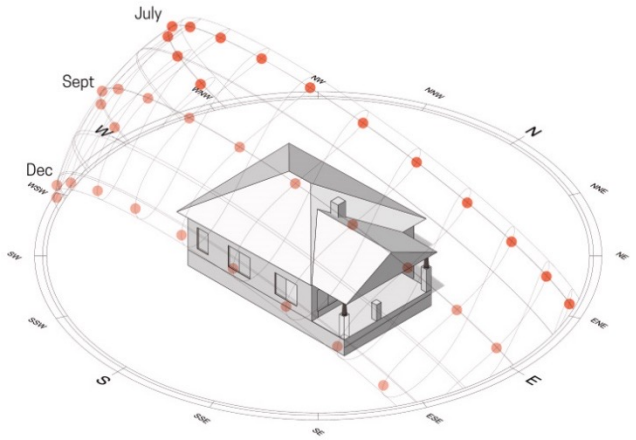
Not conforming to the modern needs

# CLIMATE ANALYSIS

ENGLISH AVENUE YELLOW JACKETS

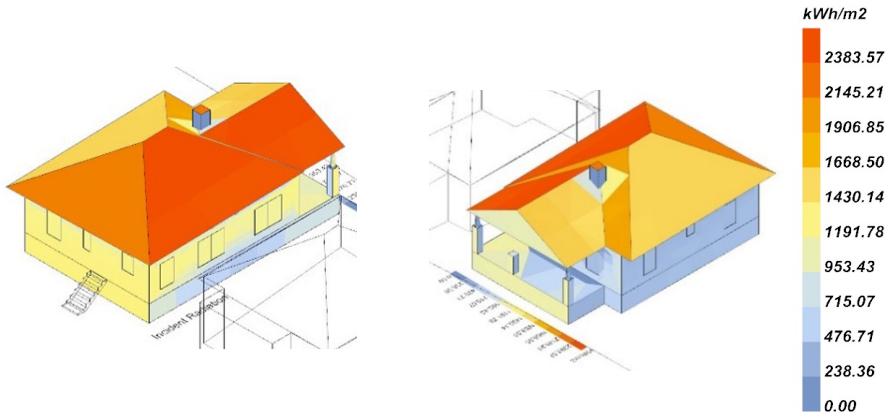



RISING TEMPERATURES

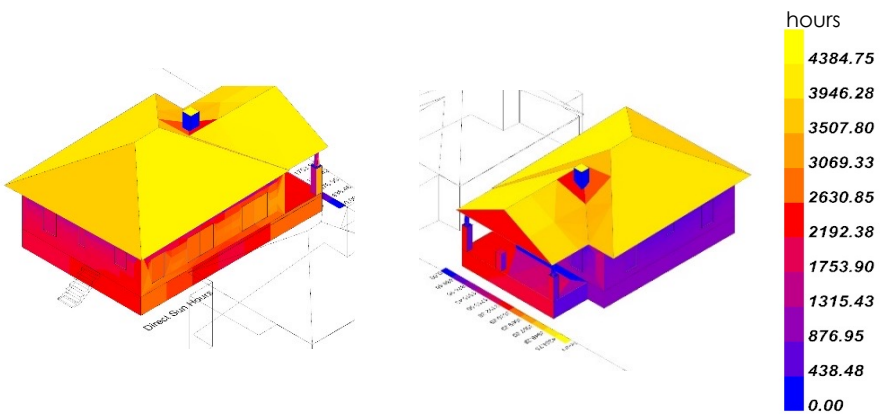



SUN PATH DIAGRAM

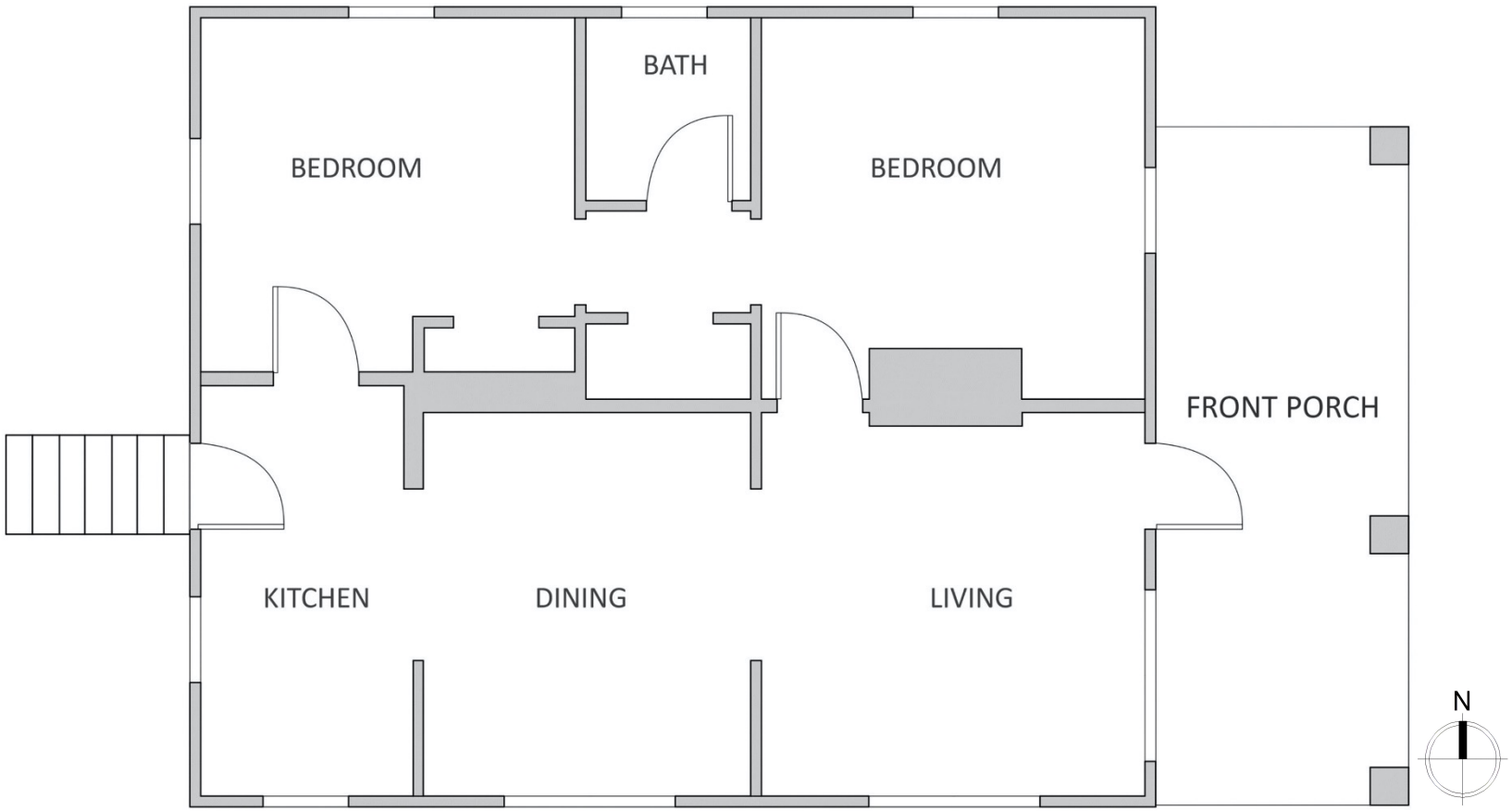

VARYING RH LEVELS



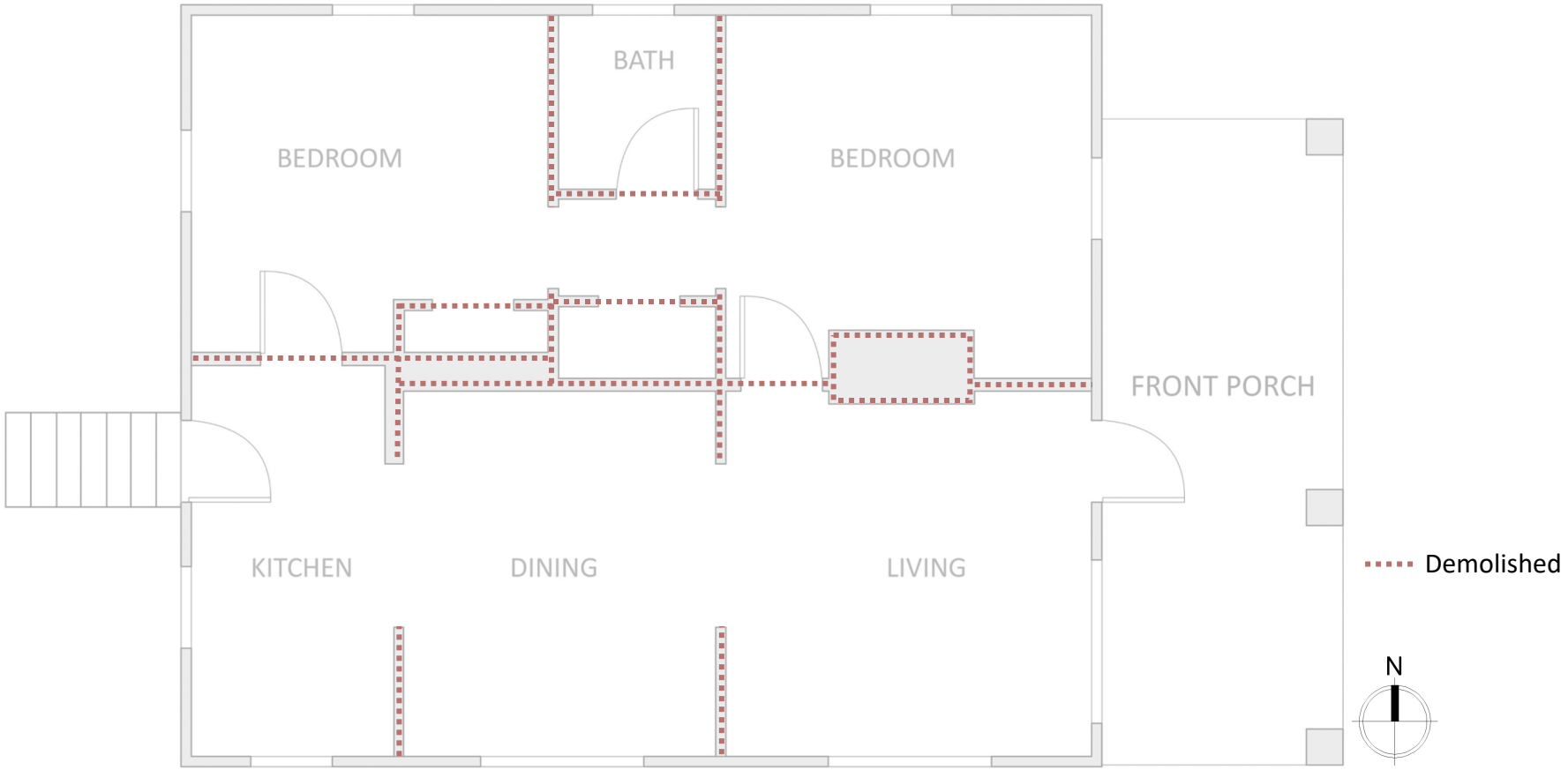

ANNUAL INCIDENT RADIATION



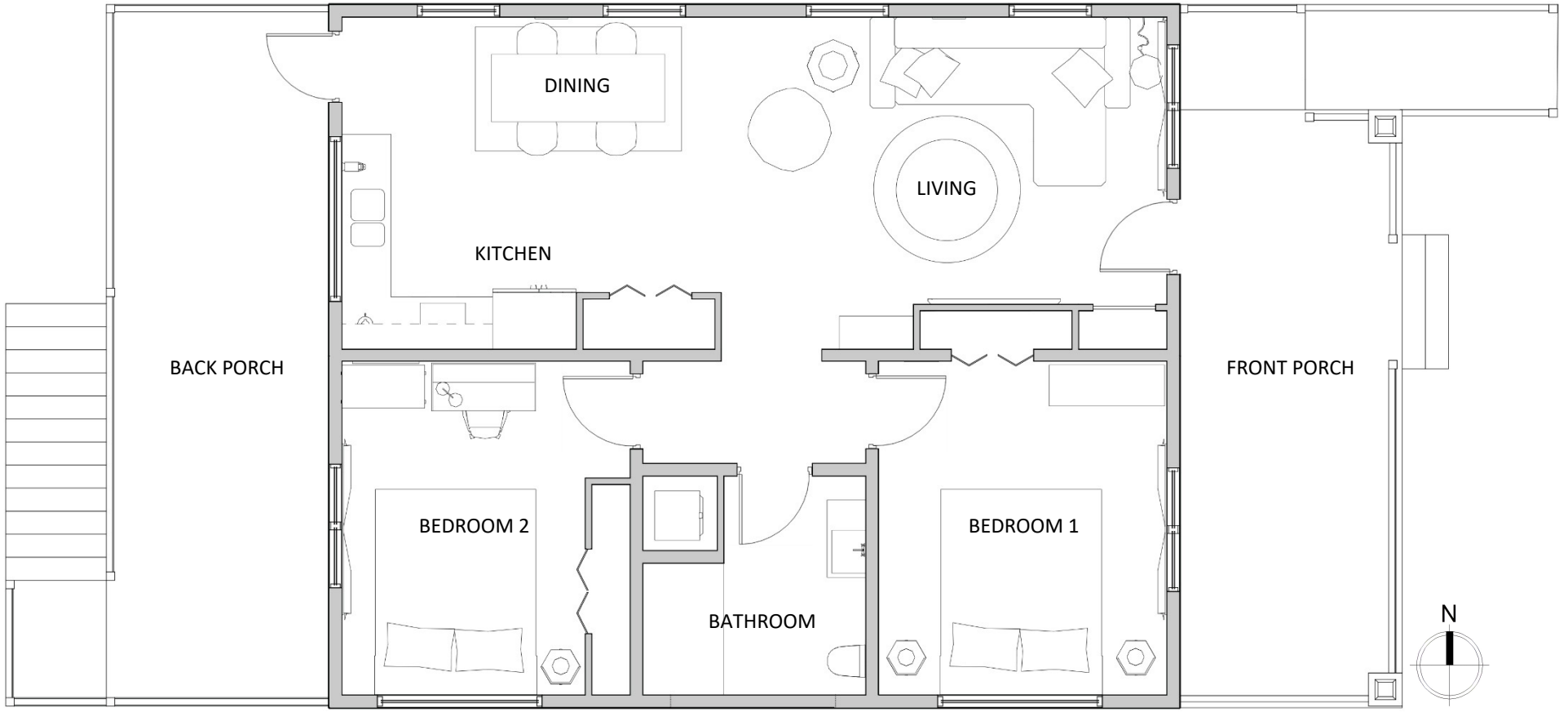

ANNUAL SUNLIGHT HOURS




EXISTING LAYOUT




DEMOLITION PLAN




PROPOSED LAYOUT

# ARCHITECTURE
## PROPOSED LAYOUT



PROPOSED FLEXIBLE LAYOUT

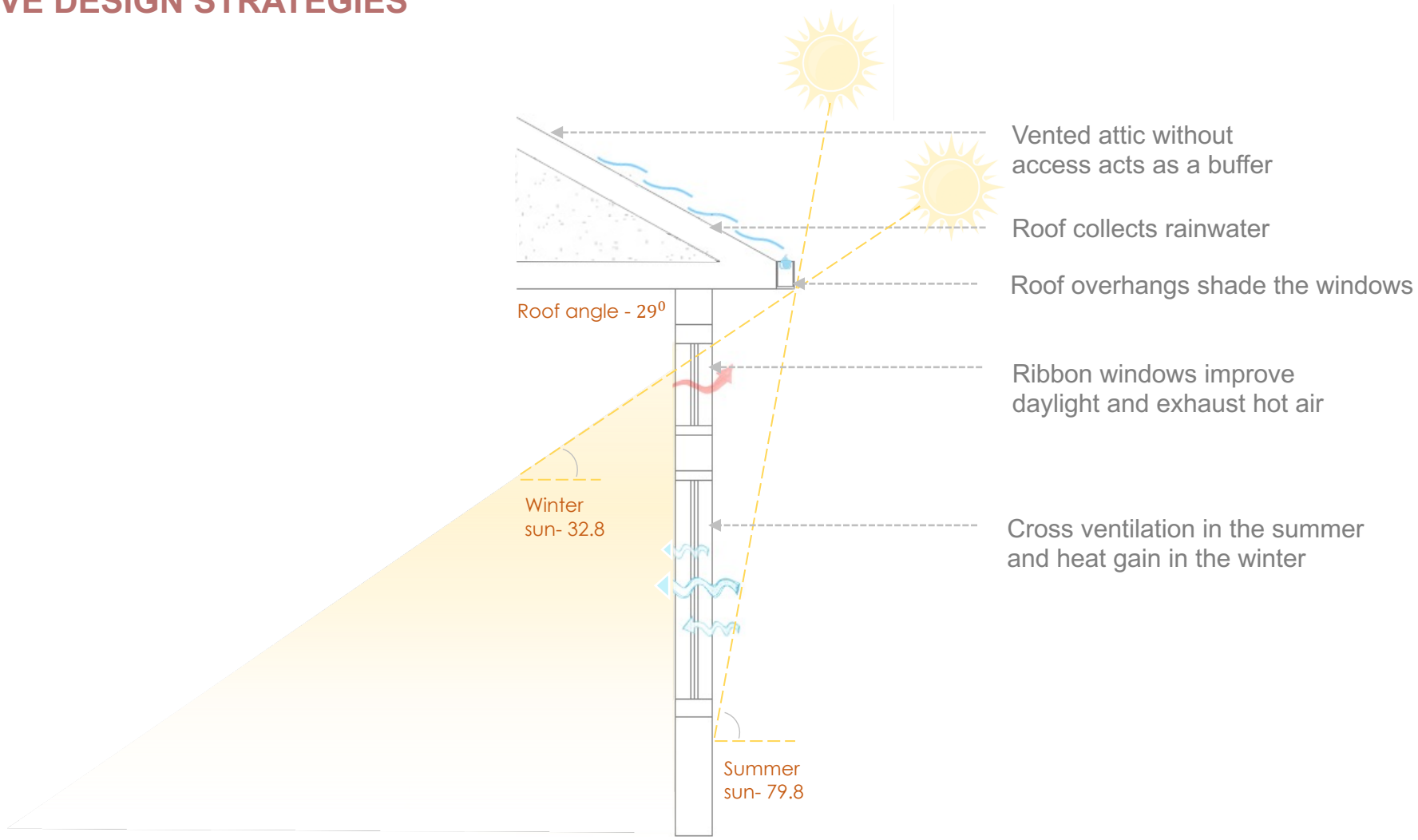
N

FLEXIBLE

ACCESSIBLE

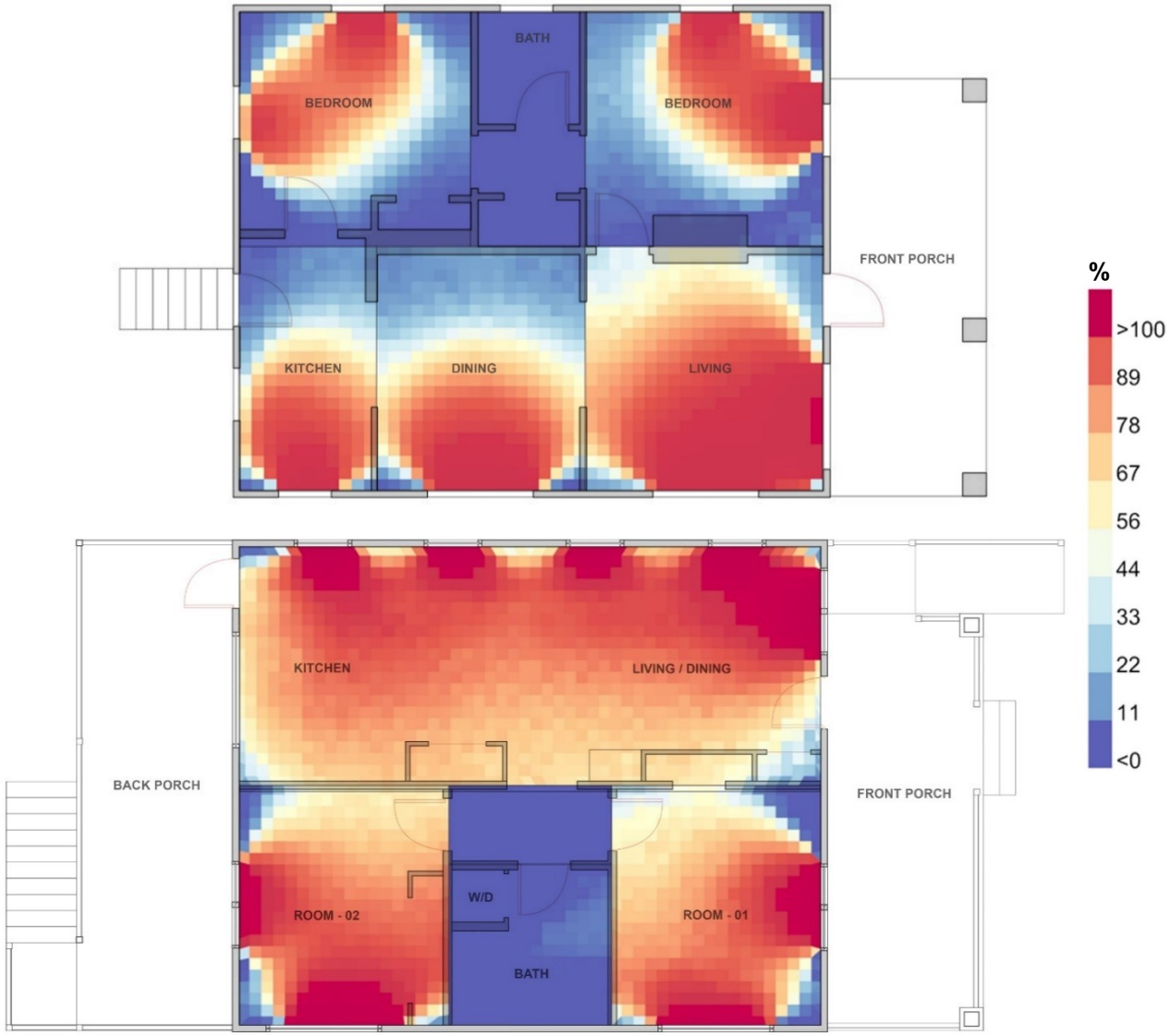
PERFORMING

# PASSIVE DESIGN STRATEGIES




## WINDOWS AND ROOF PASSIVE STRATEGIES

# SPATIAL DAYLIGHT AUTONOMY (sDA)



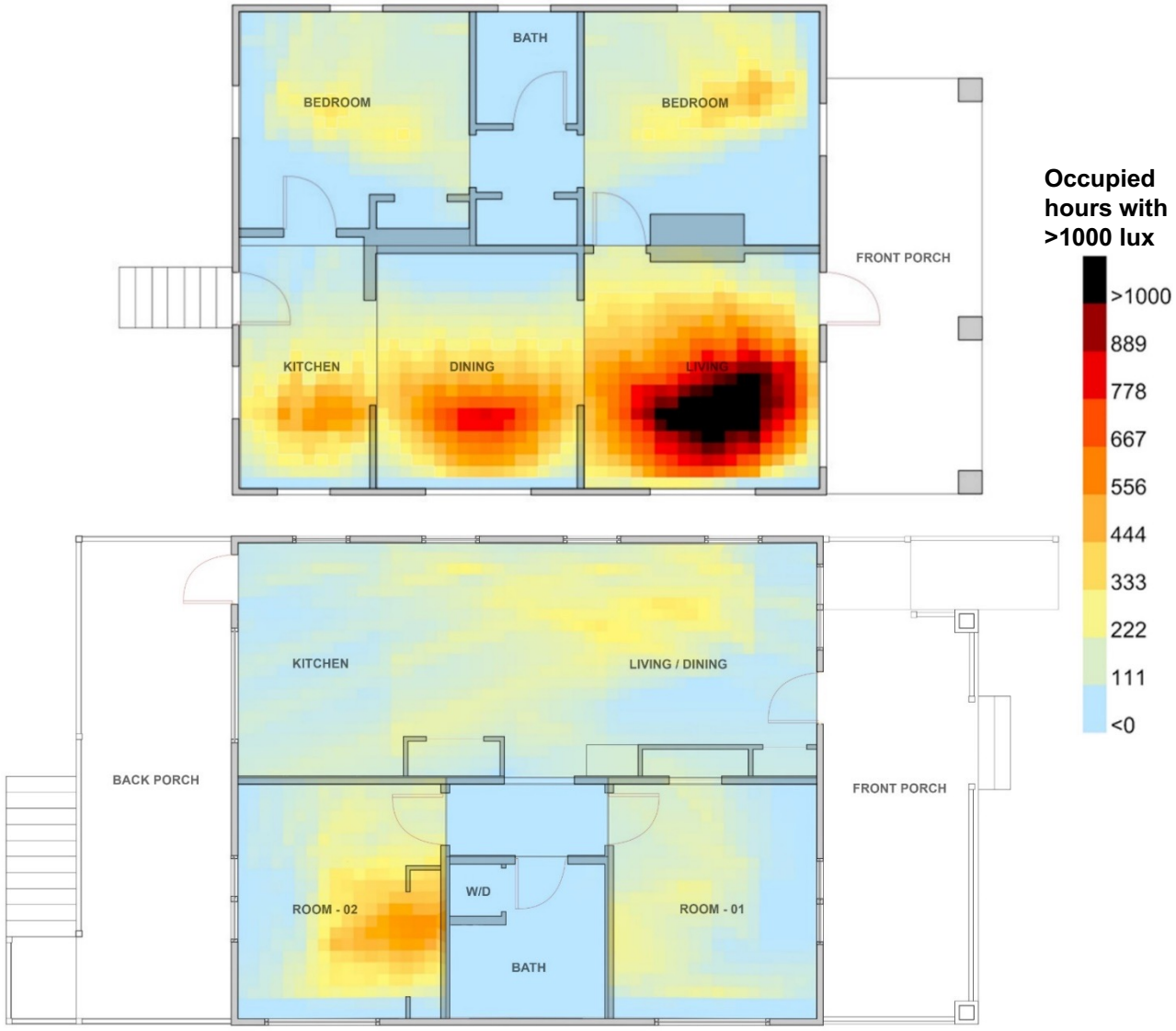

## EXISTING HOUSE

Daylight Autonomy of the liveable spaces sDA of the Existing building – **54% at 300 lux**

## PROPOSED RETROFIT HOUSE

Daylight Autonomy of the liveable spaces sDA of the Proposed Retrofitted Building – **72% at 300 lux**

# OCCUPANT EXPERIENCE
## ANNUAL SUNLIGHT EXPOSURE (ASE)




### EXISTING HOUSE

Annual Solar Exposure - **29%**

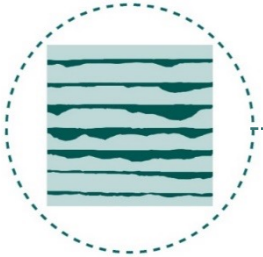
### PROPOSED RETROFIT HOUSE

Annual Solar Exposure - **6%**
LEED Recommendation **<10%**

# EMBODIED ENVIRONMENTAL IMPACT
## MATERIAL SELECTION

Wall Framing

Foundations



Plaster and Lath

Hardwood Floors

Dense Pack Cellulose

ZIP Sheathing

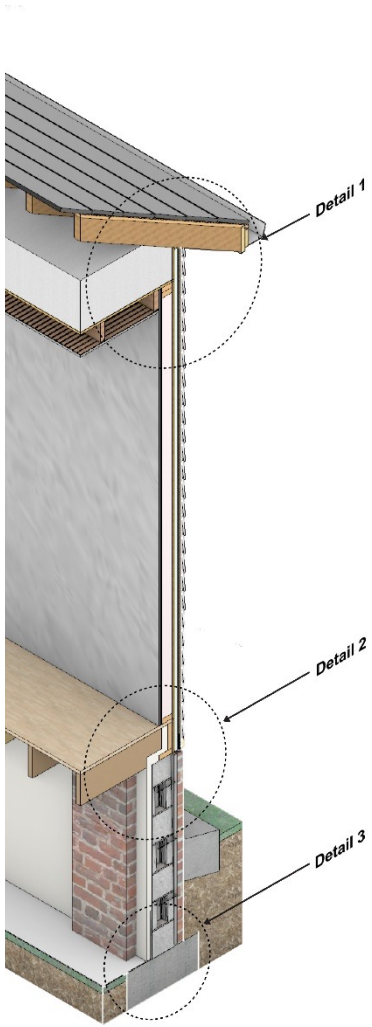
Closed Cell Spray Foam

Mineral Wool Board

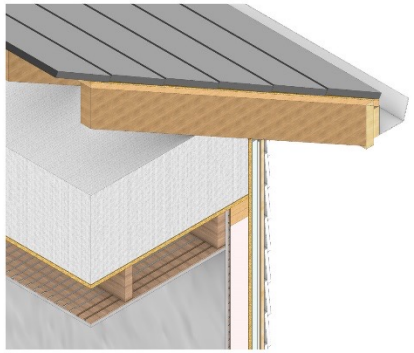
**EXISTING MATERIALS**

**NEW MATERIALS**

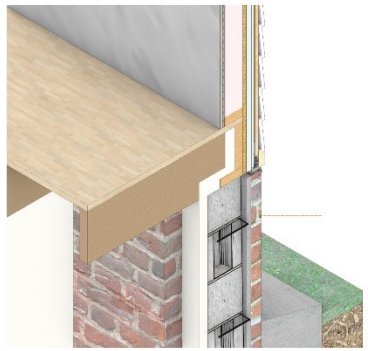
# ENVELOPE MATERIAL ASSEMBLY



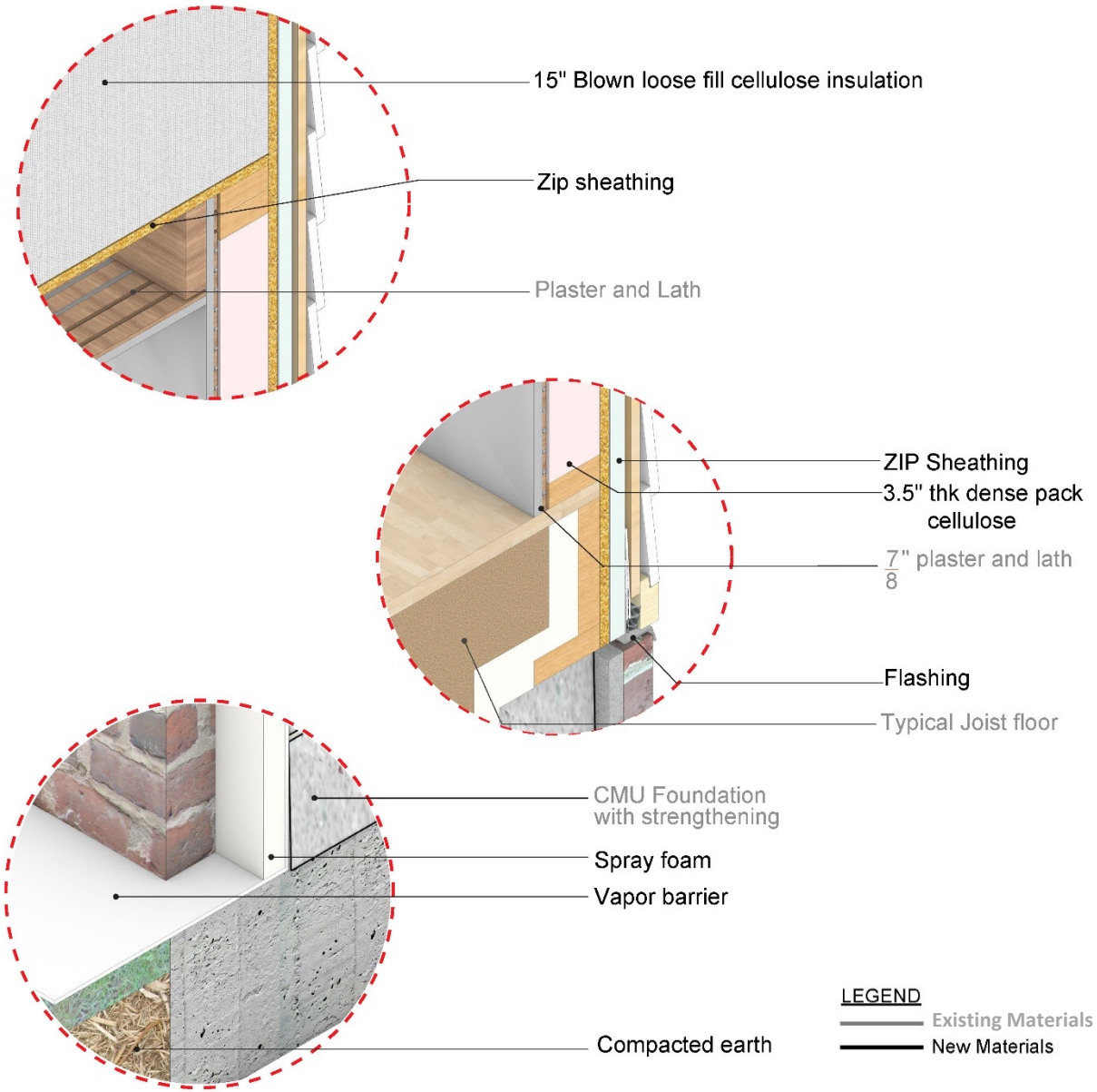

Detail 1



Detail 2



Detail 3




## TYPICAL WALL SECTION (MATERIAL ASSEMBLY)

# HVAC SYSTEM

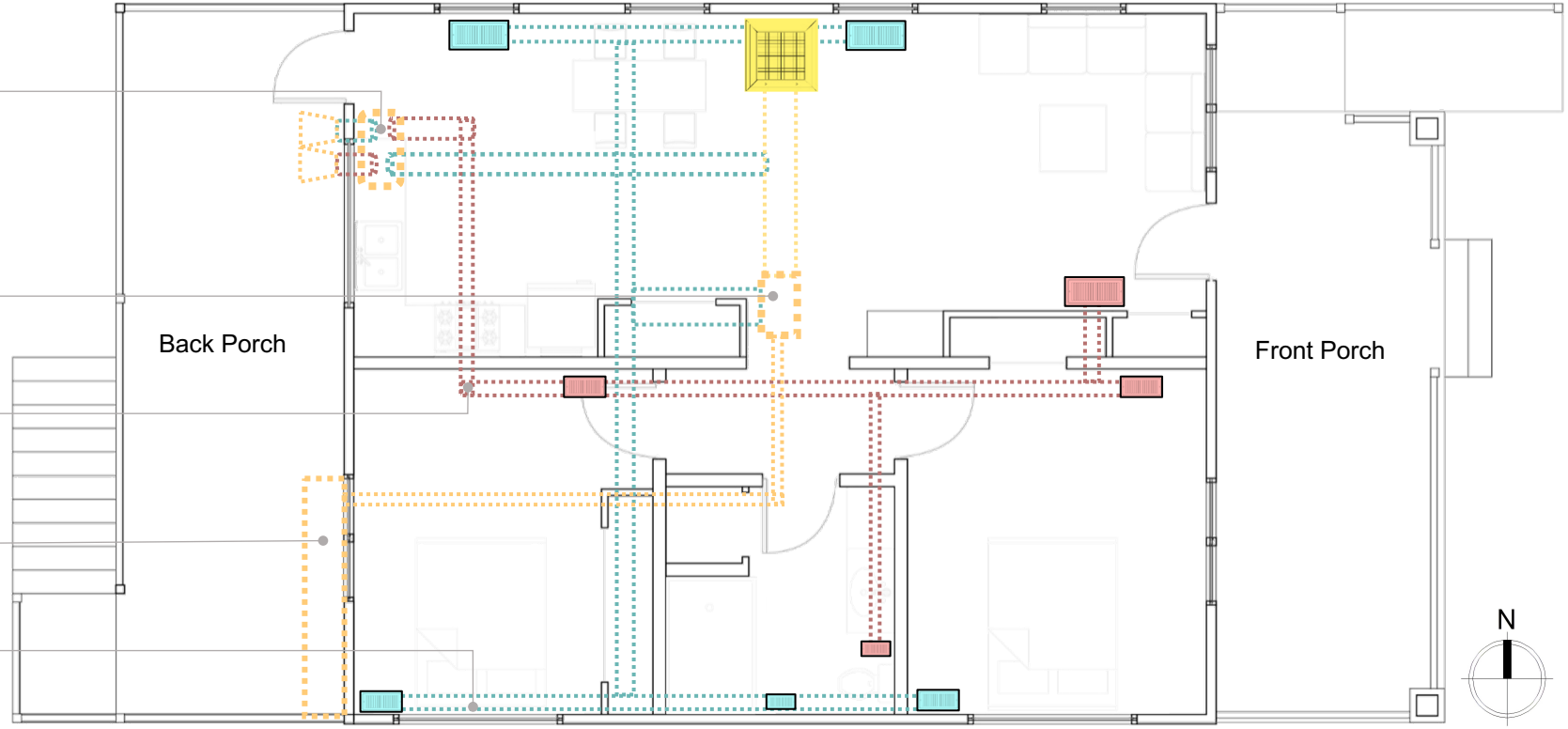
Energy Recovery Ventilator (ERV)

MERV 13 Filters

Rigid Ductwork with Mastic

18 SEER, 11 HSPF, 24,000 Btu Ducted Mini-split Heat Pump

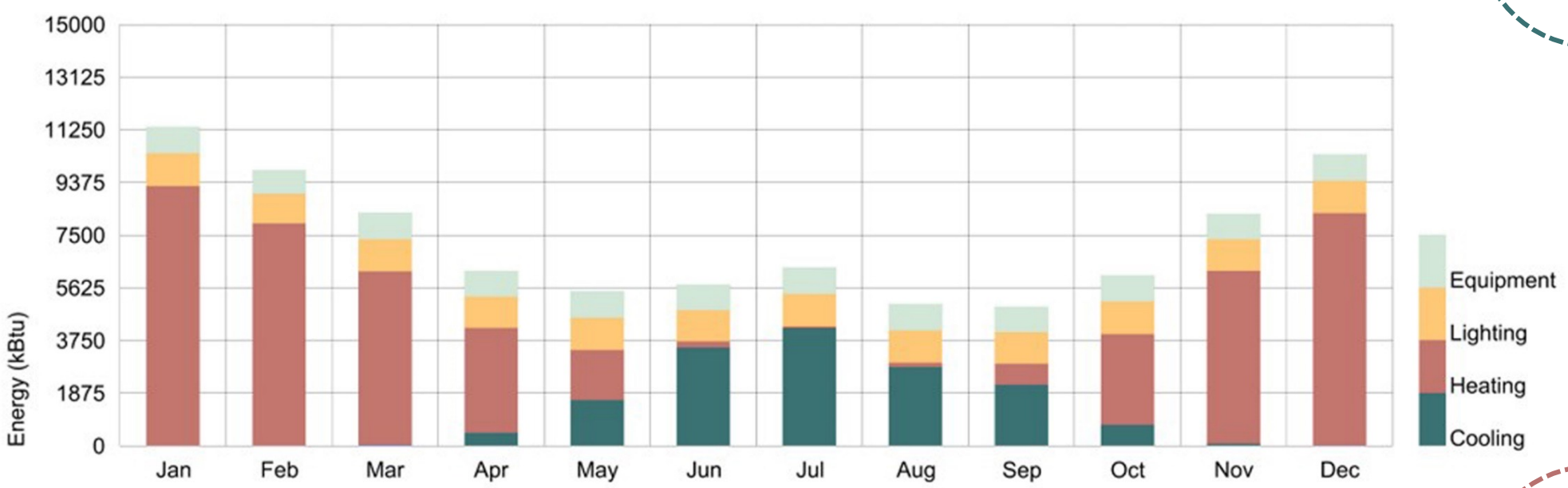
Short Duct Runs




HVAC SYSTEM LAYOUT

# ENERGY USE INTENSITY (EUI)

**EUI**
**49.5 kBtu/sf annually**

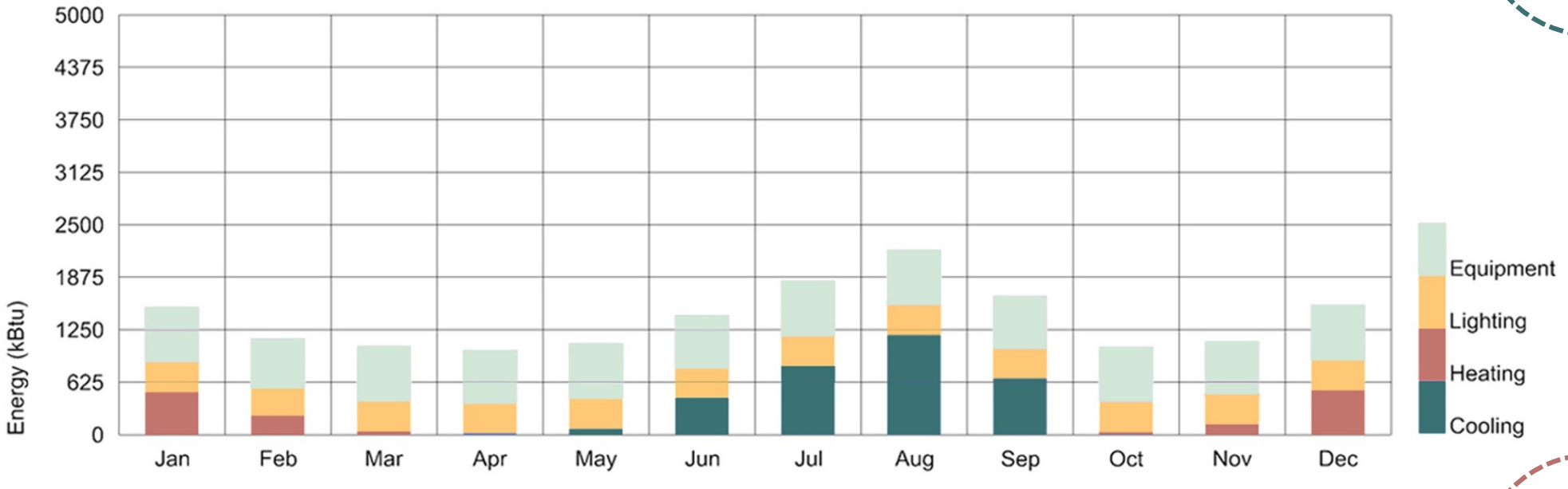



EXISTING EUI LEVEL

**BASELINE HERS**
**75**

# ENERGY PERFORMANCE
## ENERGY USE INTENSITY (EUI)

**EUI**
**12.09 kBtu/sf annually**

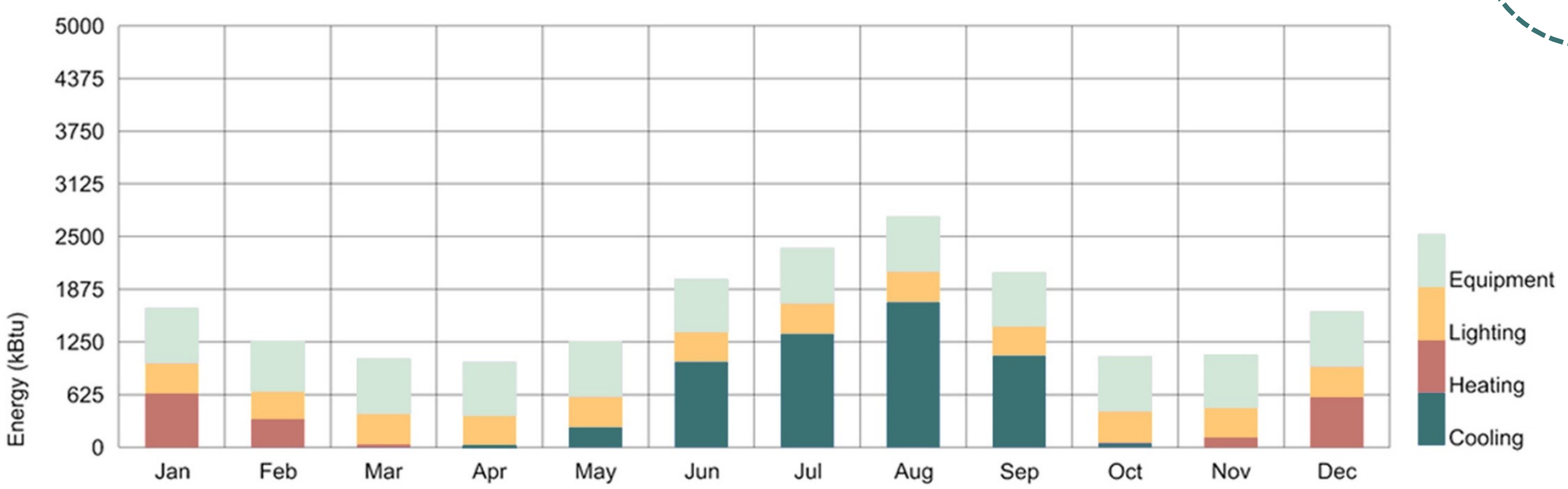



**PROPOSED EUI LEVEL 2020**

**HERS**
**w/o PV**
**44**

# ENERGY PERFORMANCE
## ENERGY USE INTENSITY (EUI)

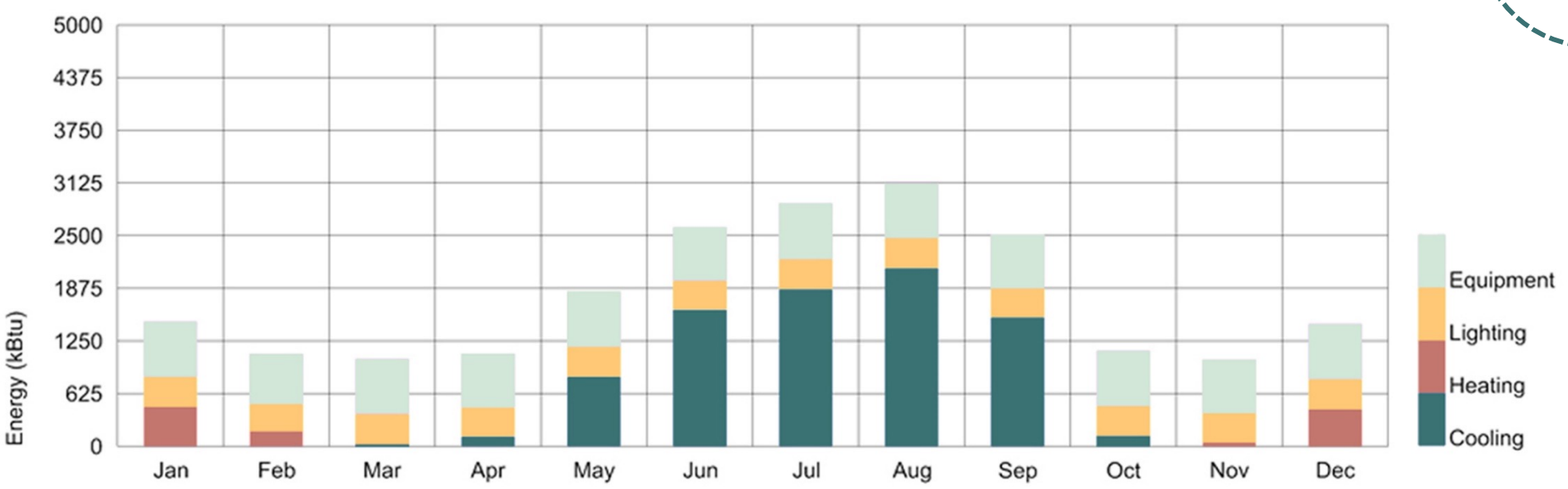
**EUI**
**12.5 kBtu/sf annually**




**PROPOSED EUI LEVEL 2050**

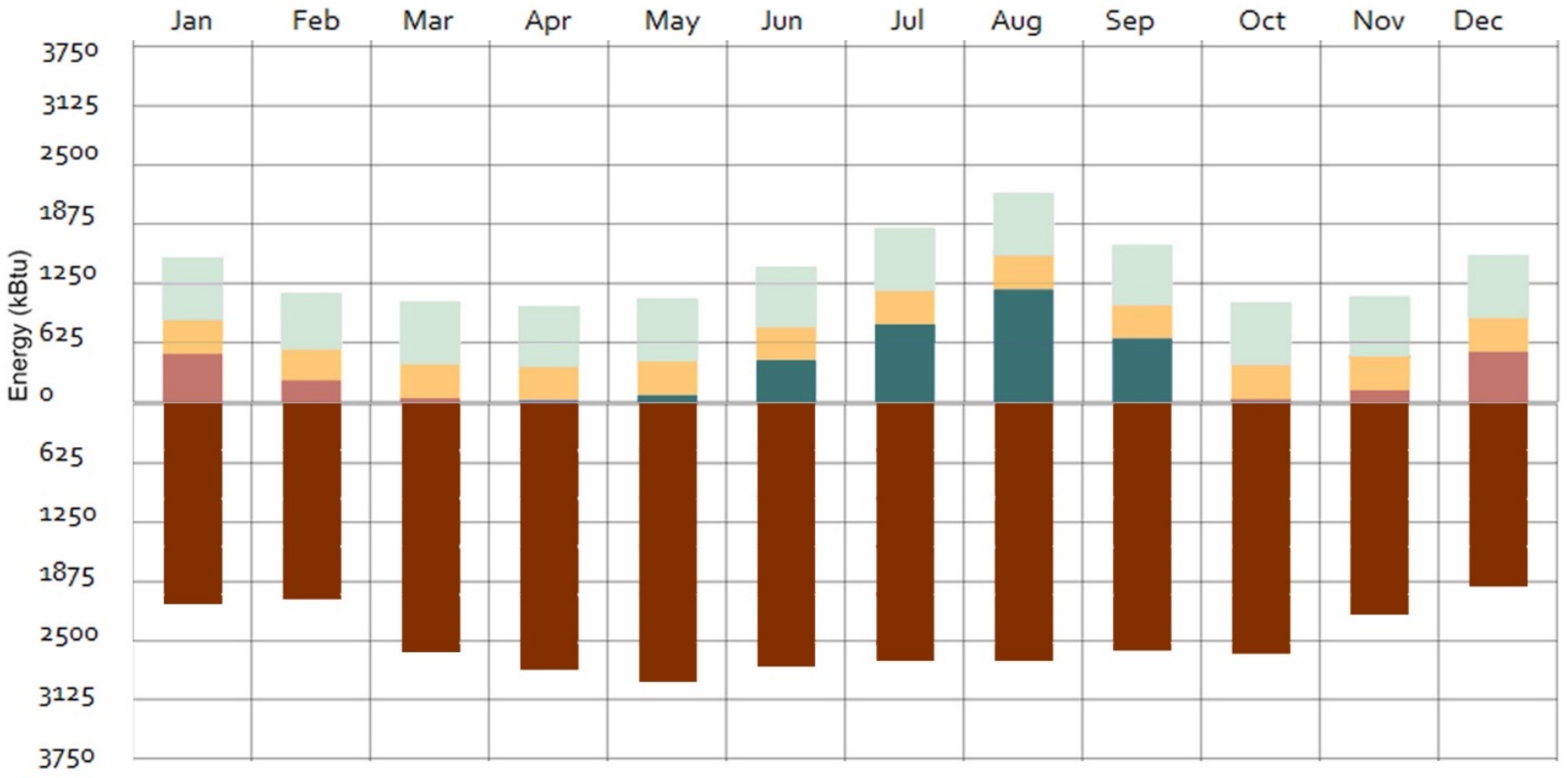
# ENERGY PERFORMANCE
## ENERGY USE INTENSITY (EUI)

**EUI**
**13.2 kBtu/sf annually**




**PROPOSED EUI LEVEL 2080**

# ENERGY PERFORMANCE
## ENERGY USE INTENSITY (EUI)

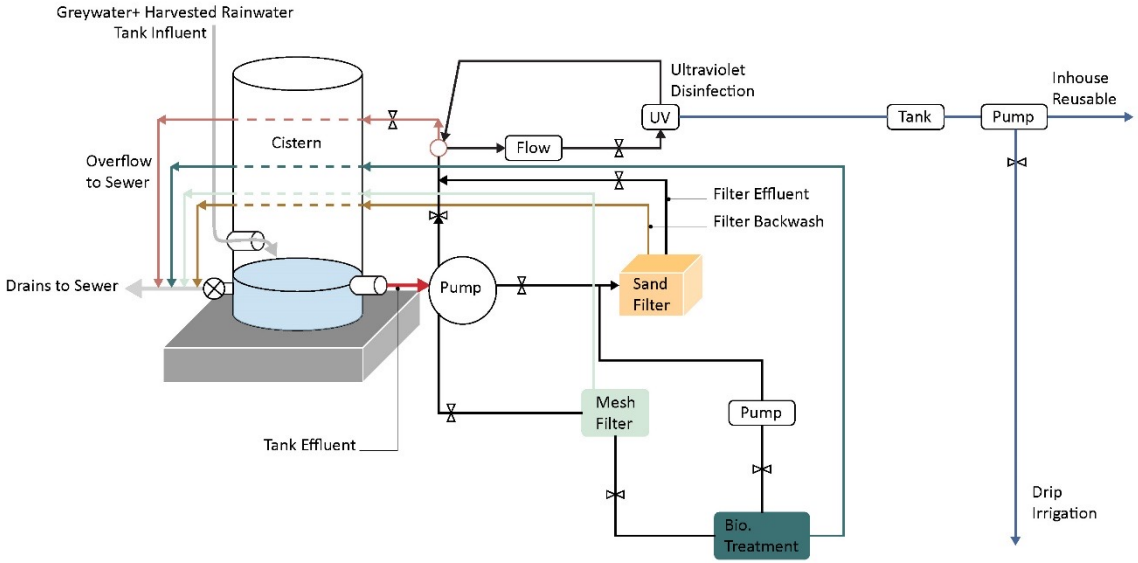



**NET EUI**
**-2.86 kBtu/sf annually**

**FINAL HERS**
**-1**

**PROPOSED NET EUI WITH PV PANELS 2020**

# ENGINEERING
# WATER SYSTEMS

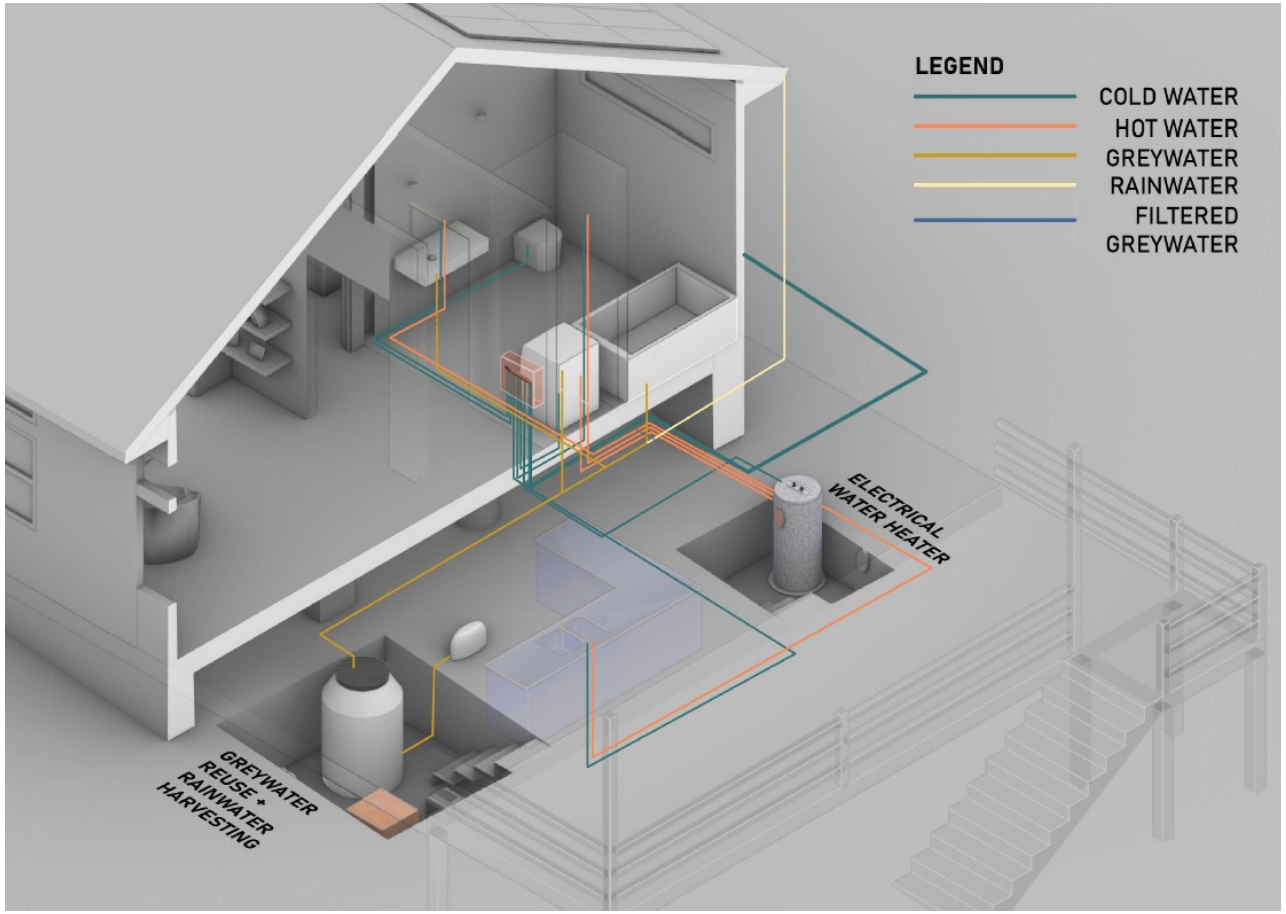



GREYWATER REUSE AND RAINWATER HARVESTING SYSTEM

**Cistern size: 6000 Gallons**

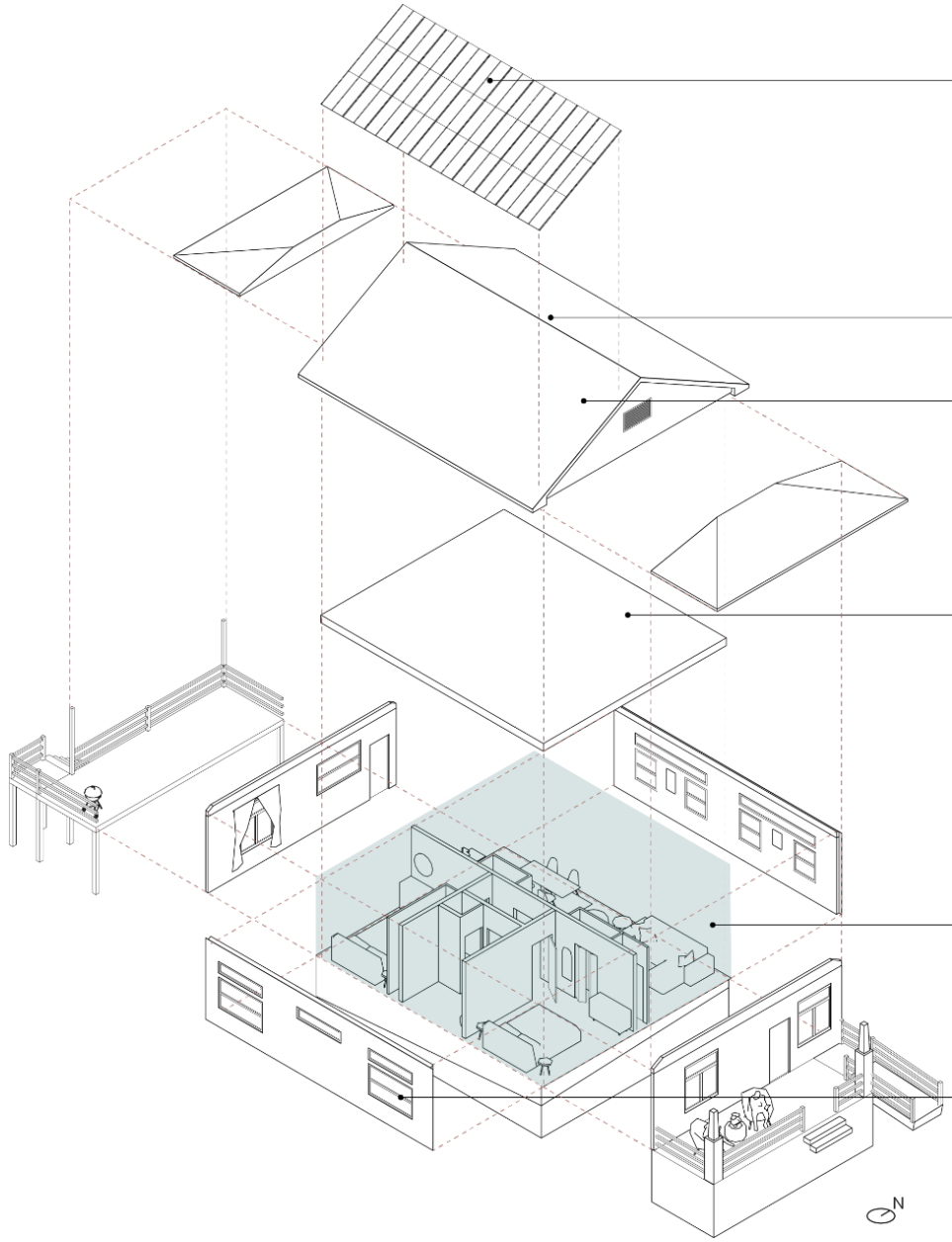
**Design roof catchment area : 149 sq ft**

**Rainwater Harvesting potential: 26205 Gallons/yr**




INTEGRATED WATER SYSTEMS

# INTEGRATED PERFORMANCE

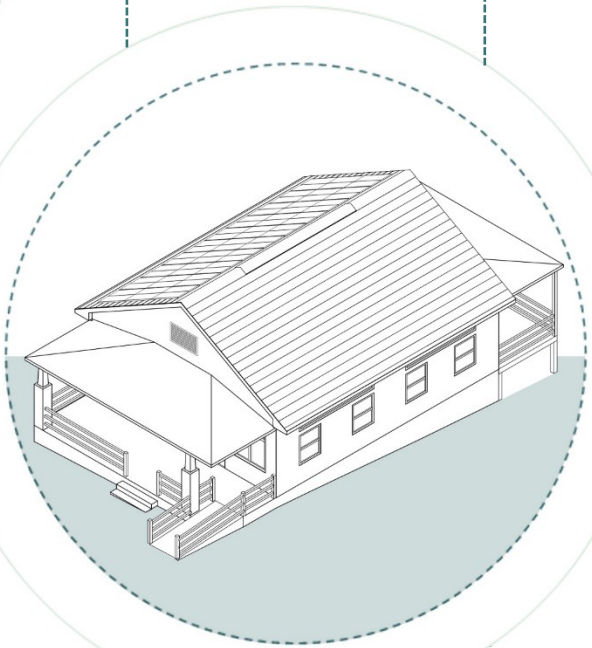


# OCCUPANT EXPERIENCE

ENGLISH AVENUE YELLOW JACKETS

Simplified Roofing

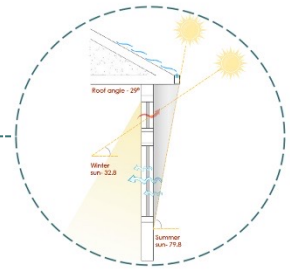
Activated Outdoor Space



Energy Management

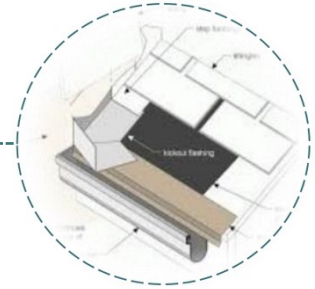
Appliance Efficiency

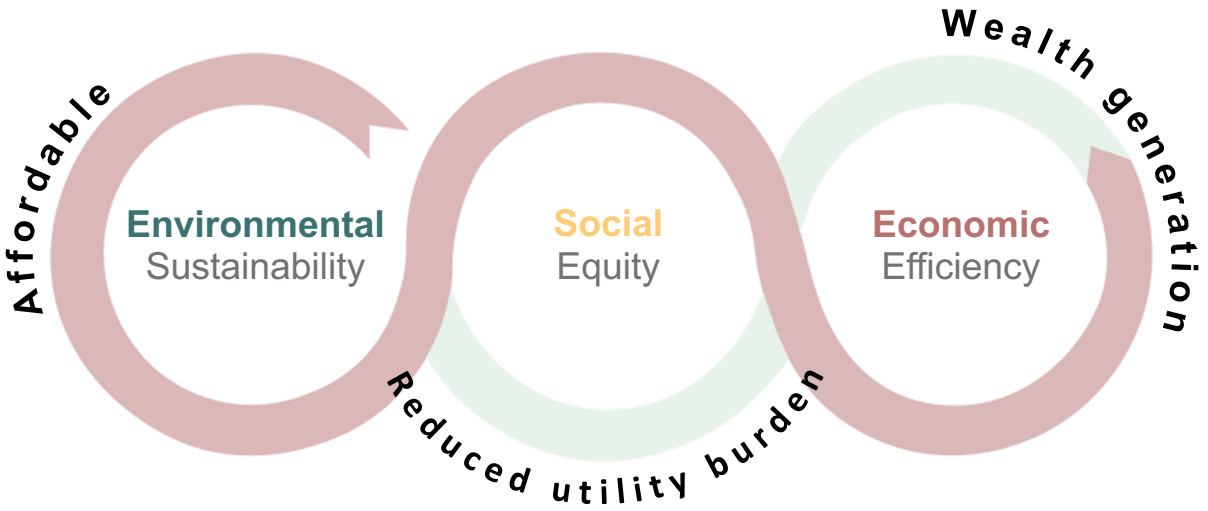

Efficient Daylighting



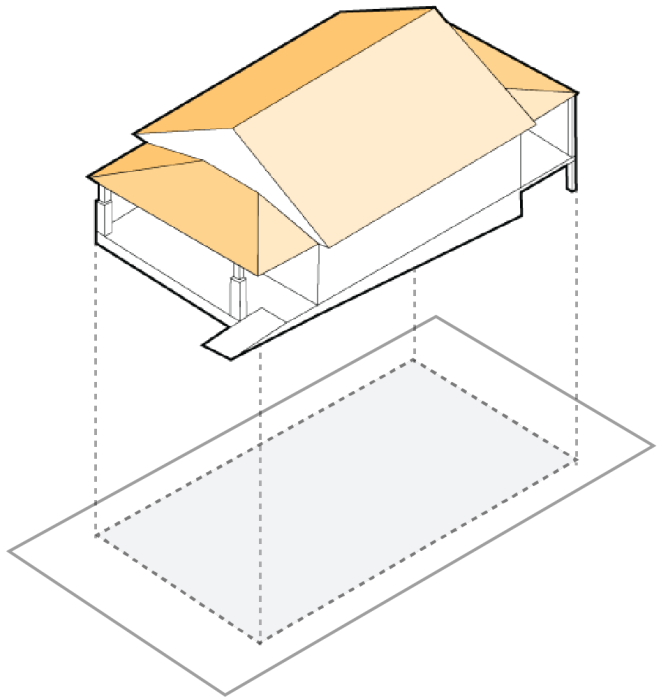
Privacy and Security

Reduced Maintenance

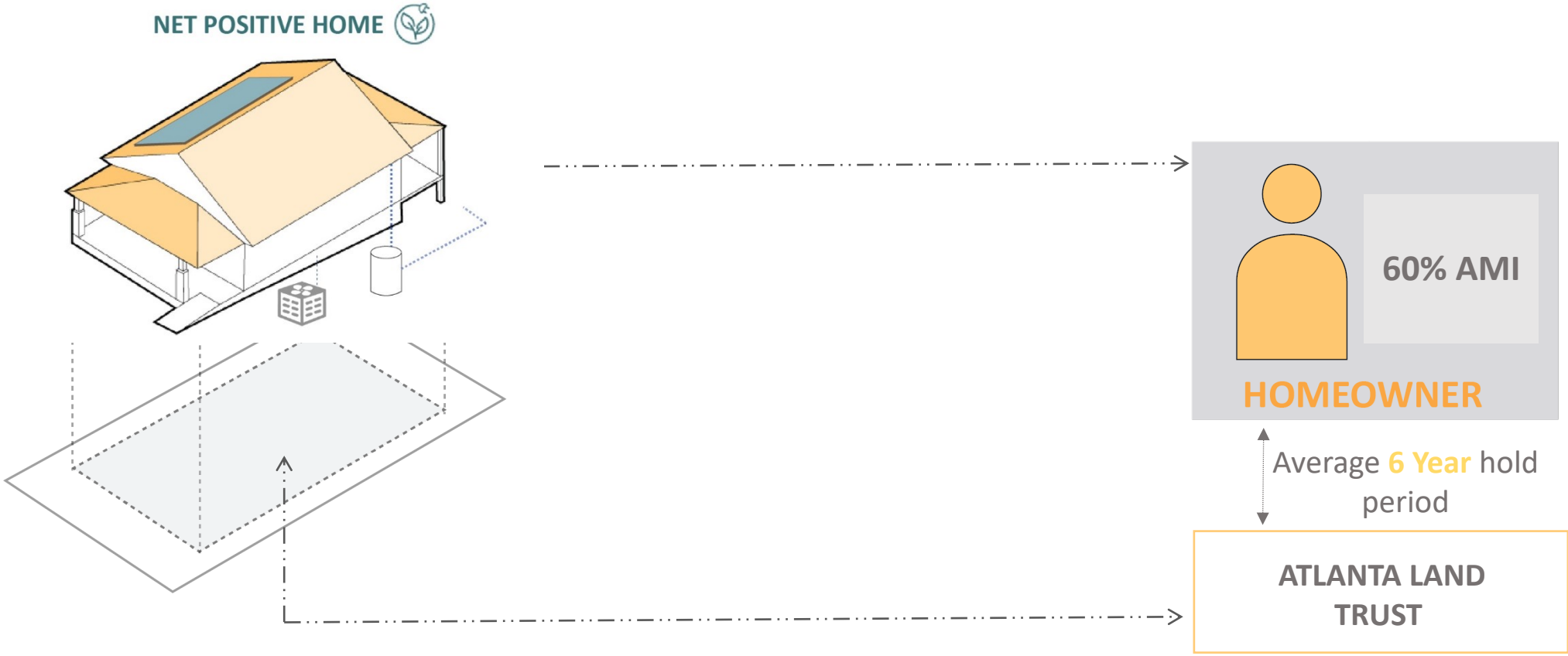



Affordable
Environmental
Sustainability
Social
Equity
Economic
Efficiency
Wealth generation
Reduced utility burden

# BUDGET ANALYSIS

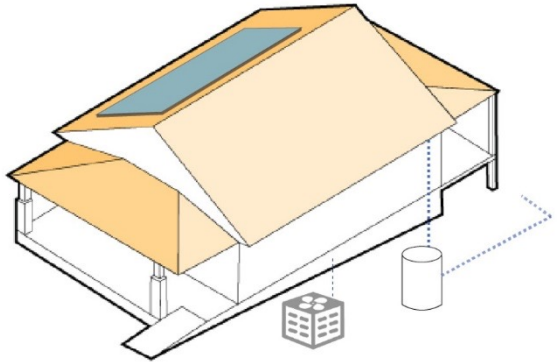


# BUDGET ANALYSIS



# MARKET ANALYSIS
## BUDGET ANALYSIS

NET POSITIVE HOME



HOUSE COST: **$229,680**

ATLANTA LAND TRUST

**STEWARDSHIP FUND**
- Maintenance cost

**REDUCED PROPERTY TAX**

**WESTSIDE FUTURE FUND**

NEW MARKET TAX CREDIT GRANT
**$33,000**

INVEST ATLANTA ASSISTANCE
**$20,000**

ATLANTA HOUSING AUTHORITY (AHA)
**$10,000**

WFF SUBSIDY
**$27,000**

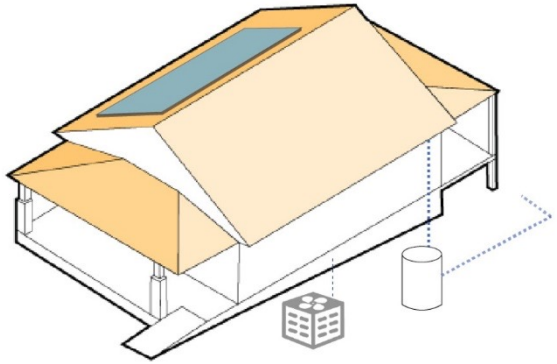
SUBSIDIES: **$90,680**

60% AMI

**HOMEOWNER**

# MARKET ANALYSIS
## BUDGET ANALYSIS

NET POSITIVE HOME



(HOUSE COST)

ATLANTA LAND TRUST

(LAND COST)

WESTSIDE FUTURE FUND

NEW MARKET TAX CREDIT GRANT
$33,000

INVEST ATLANTA ASSISTANCE
$20,000

ATLANTA HOUSING AUTHORITY (AHA)
$10,000

WFF SUBSIDY
$27,000

(SUBSIDIES BUNDLE)

60% AMI

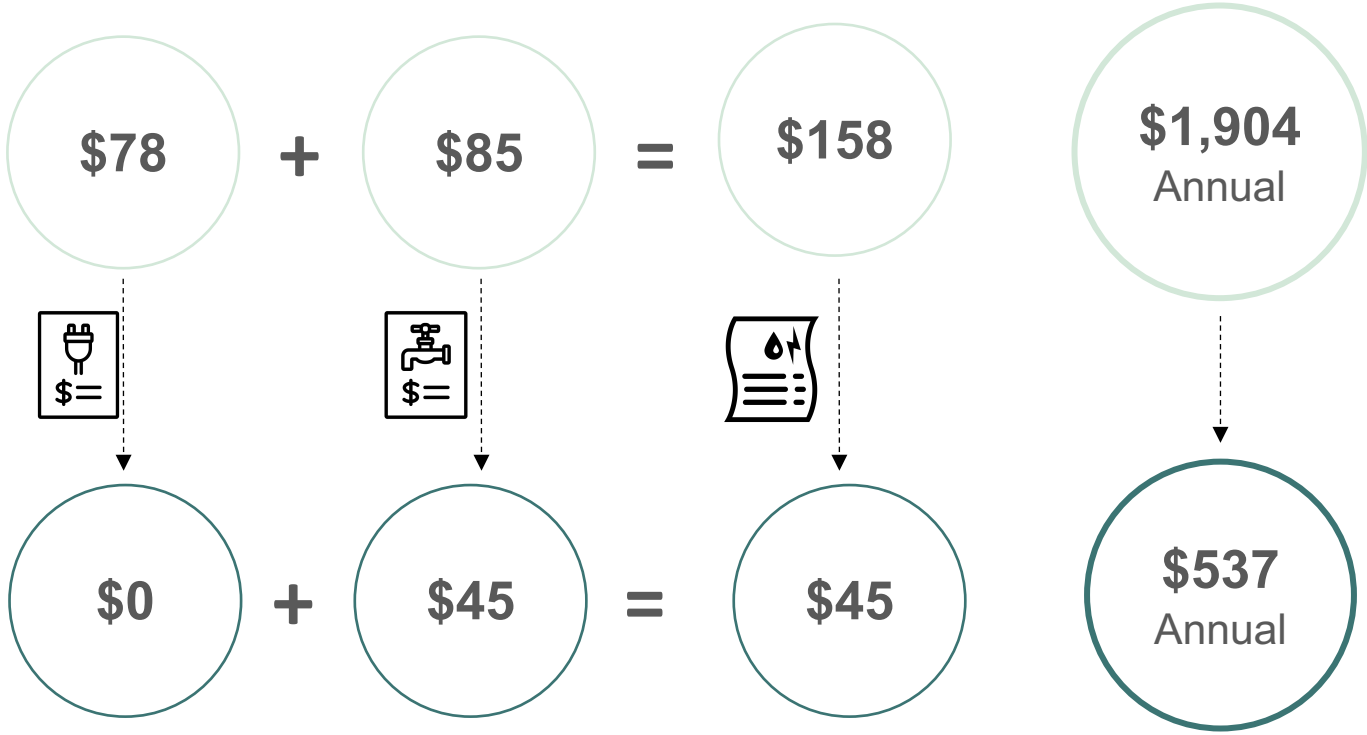
HOMEOWNER

HOUSE COST: $229,680
Less SUBSIDIES: ($90,680)
**HOMEOWNER'S COST: $139,680**

# MARKET ANALYSIS
## UTILITY COST

ENGLISH AVENUE YELLOW JACKETS

ANNUAL SINGLE FAMILY HOUSING UTILITY COSTS IN ENGLISH AVENUE




**Utility Savings!**

$ 113
per month

**$ 1,368**
per Year

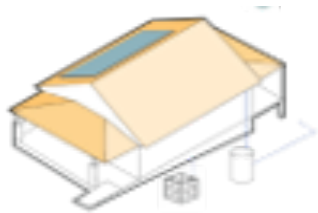
**72%**

NET-POSITIVE HOME UTILITY COSTS

# MARKET ANALYSIS
## WEALTH CREATION

ENGLISH AVENUE YELLOW JACKETS

| | Y-1 | Y-2 | Y-3 | Y-4 | Y-5 | Y-6 |
|---|---|---|---|---|---|---|
| HOMEOWNER EQUITY SHARE | | | | | | $ 59,855 |
| UTILITY SAVINGS | $ 1,347 | $ 1,410 | $ 1,454 | $ 1,499 | $ 1,545 | $ 1,593 |
| PROPERTY TAX SAVINGS | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 |
| MAINTENACE SAVINGS | $ 946 | $ 975 | $ 1,006 | $ 1,037 | $ 1,069 | $ 1,102 |
| Total | $ 3,757 | $ 3,829 | $ 3,903 | $ 3,979 | $ 4,058 | $ 63,994 |

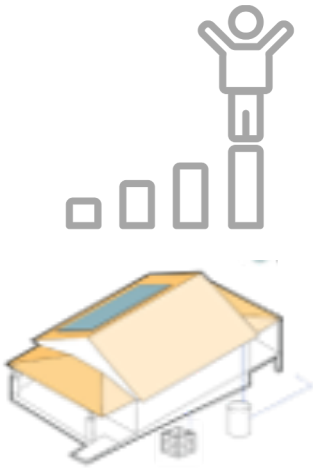


**NPV**
**$ 71,090**
6 Years

# MARKET ANALYSIS
## WEALTH CREATION

ENGLISH AVENUE YELLOW JACKETS

| | Y-1 | Y-2 | Y-3 | Y-4 | Y-5 | Y-6 |
|---|---|---|---|---|---|---|
| HOMEOWNER EQUITY SHARE | | | | | | $ 59,855 |
| UTILITY SAVINGS | $ 1,347 | $ 1,410 | $ 1,454 | $ 1,499 | $ 1,545 | $ 1,593 |
| PROPERTY TAX SAVINGS | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 | $ 1,444 |
| MAINTENACE SAVINGS | $ 946 | $ 975 | $ 1,006 | $ 1,037 | $ 1,069 | $ 1,102 |
| Total | $ 3,757 | $ 3,829 | $ 3,903 | $ 3,979 | $ 4,058 | $ 63,994 |



**NPV**
**$ 71,090**
6 Years

# PROPOSED SITE LAYOUT


Pitch roof
Architecture language
Front porch
Community interaction
Accessibility
Façade finish
Architecture language
Flexible outdoor area


# Backyard Activation

## Community Interactions


# Living/Dinning Area

## Flexible Layout

# ENGLISH AVENUE YELLOW JACKETS

2022 DESIGN CHALLENGE –RETROFIT HOUSING

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON

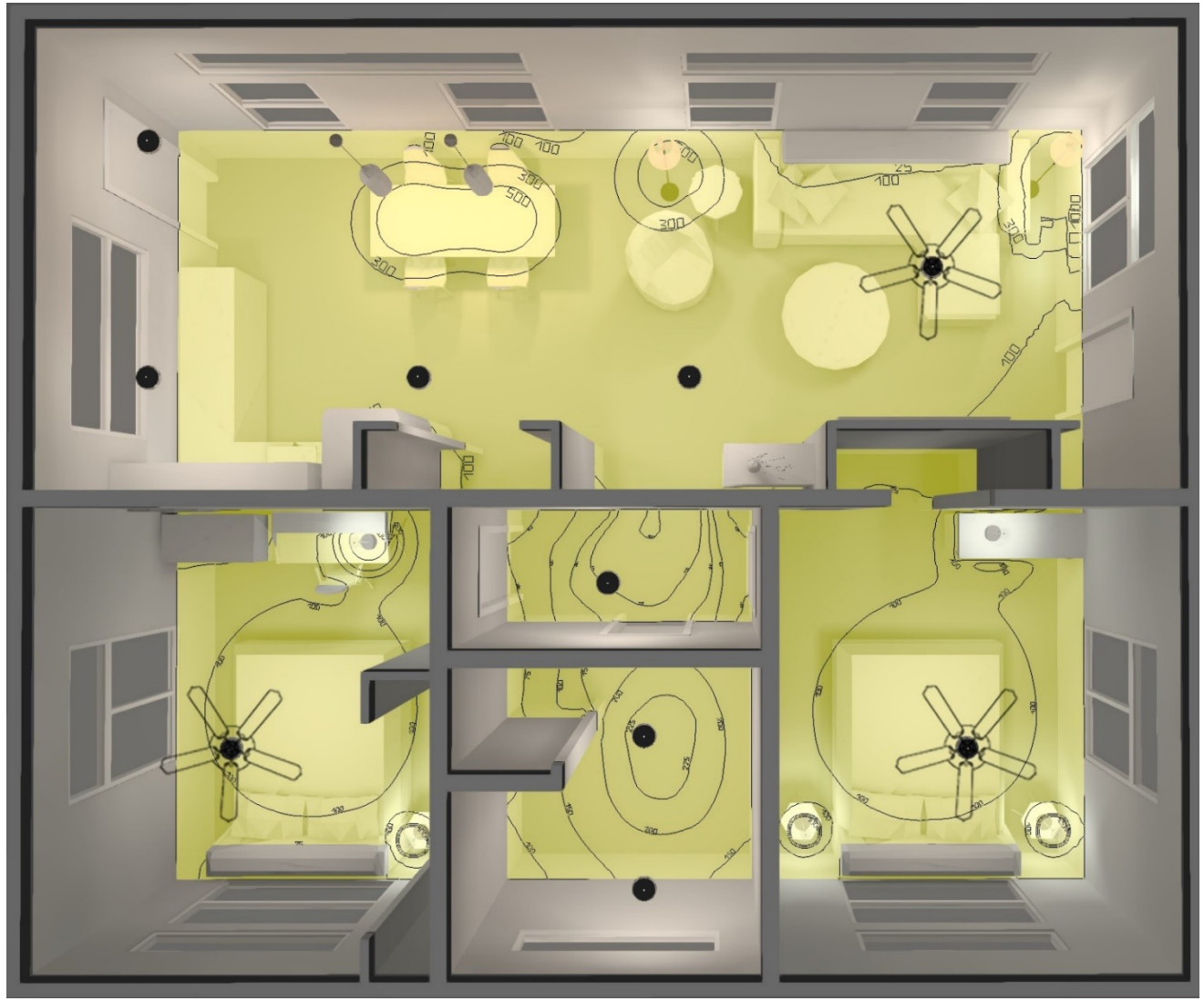
Georgia Tech

# FENESTRATION EXPLORATION

| | OPTION 1 | OPTION 2 | OPTION 3 | OPTION 4 | FINAL OPTION |
|---|---|---|---|---|---|
| EUI | 12.68 | 12.707 | 12.743 | 12.39 | **12.09** |
| ASE | 3% | 17% | 16% | 5% | **6%** |
| DA | 48.1 | 63.36 | 67.72 | 65.8 | **72** |

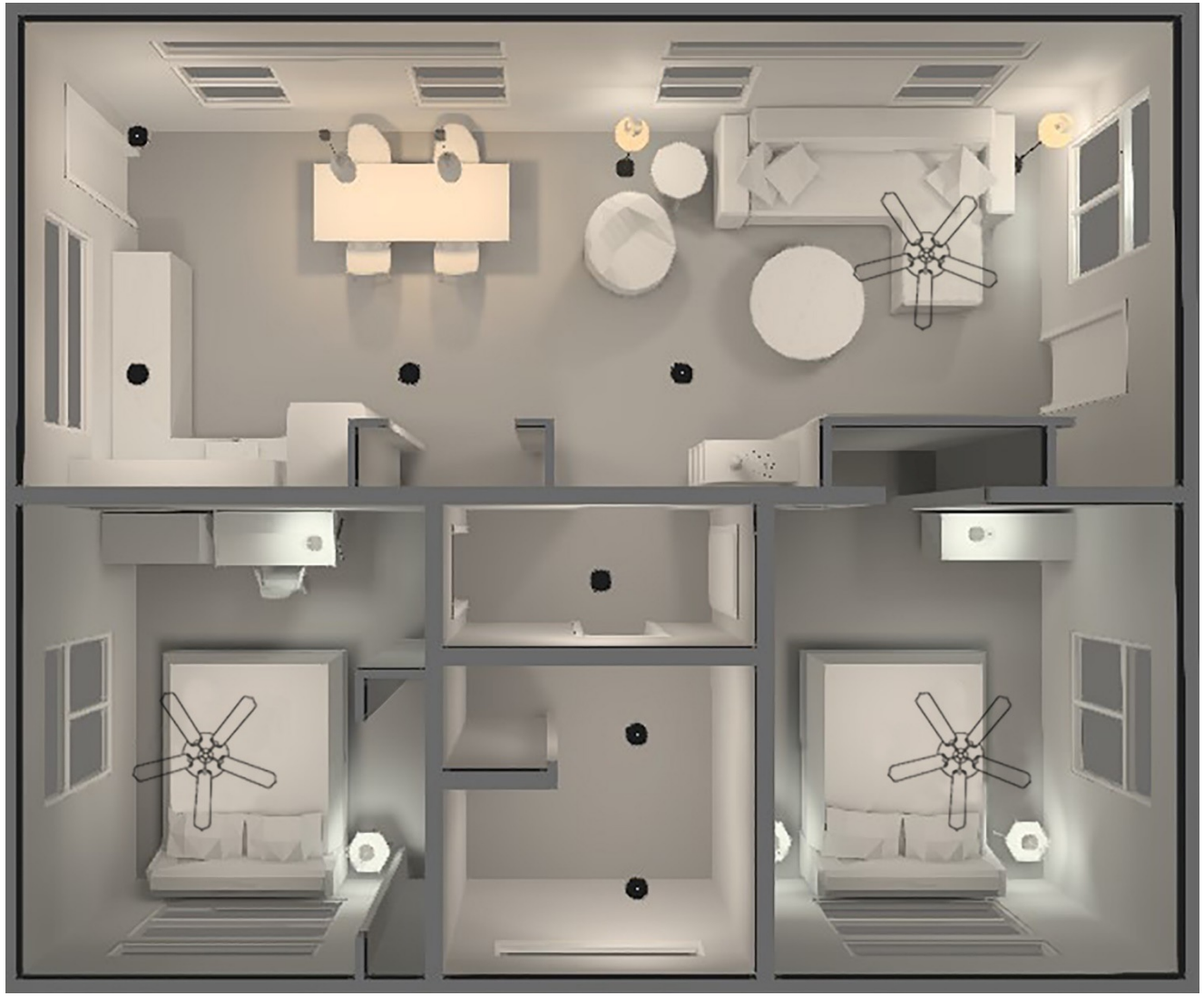
# ARTIFICIAL LIGHTING





DIA Lux analysis of lux level contours for indoor lighting

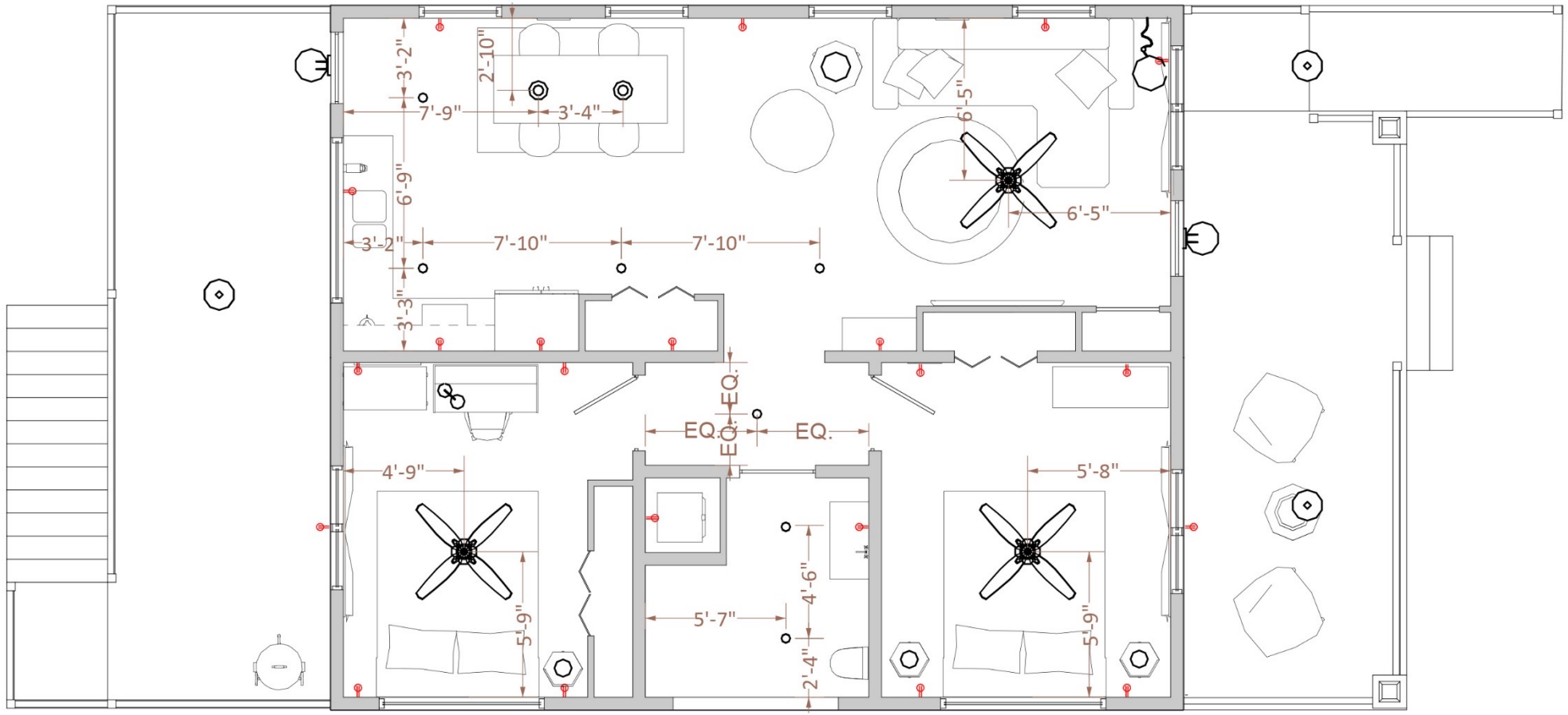
# OCCUPANT EXPERIENCE
## ARTIFICIAL LIGHTING



DIA Lux analysis of lux level contours for indoor lighting

## OCCUPANT EXPERIENCE

# ARTIFICIAL LIGHTING



# OCCUPANT EXPERIENCE
## ARTIFICIAL LIGHTING

| English Avenue Retrofit house - Luminaire list | | | | | | | |
|---|---|---|---|---|---|---|---|
| **No. of pcs.** | **Liminaire Article No.** | **Luminaire Article name** | **P (W) per fixture** | **P (W) total** | **0 (lm) per fixture** | **0 (lm) total** | **Luminous efficacy** |
| 10 | A1980141 WT | STRAM PRISMATIC 1 DIM DALI 3000K WT | 10.5 | 105 | 1435 | 14350 | 136.7 lm/W |
| 1 | 1137020A | Floor Fluorescent lamp with diffuser that is covered by parchment paper | 14 | 14 | 1527 | 1527 | 109.1 lm/W |
| 1 | 1137020A | Floor Fluorescent lamp with diffuser that is covered by parchment paper | 28 | 28 | 1527 | 1527 | 54.6 lm/W |
| 2 | HCC6W10 DO1OMB- HM612935 - 61 N DH | HCC6 LED 6" Cylinder Downlight Series | 10 | 20 | 7981 | 15962 | 79.8 lm/W |
| 3 | LK-LED 070.0730.0 565.1/DALI AOV-001/003/05.1 | LK-LED 070.0730.0565.1/DALI | 6 | 18 | 650 | 1950 | 108.4 lm/W |
| 5 | 260081.5L 02.202 | DAGALI TABLE LED 280 710lm 3000K opal matt (PMMA) white | 6 | 30 | 711 | 3555 | 118.4 lm/VV |
| 3 | MAXIM - Basic 89908SWOIWP | LED downlight with fan | 18 | 54 | 1650 | 4950 | |
| | | | | 269 | | 43821 | |
| | | | | **269 W** | | **43821 lm** | **114.0 1m/W** |
| | | | | **Ptotal** | | **Ototal** | **Luminous efficacy** |

# PV SYSTEM + GRID INTERACTION

ENGLISH AVENUE YELLOW JACKETS

**PV**
**14.95 kBtu/sf**

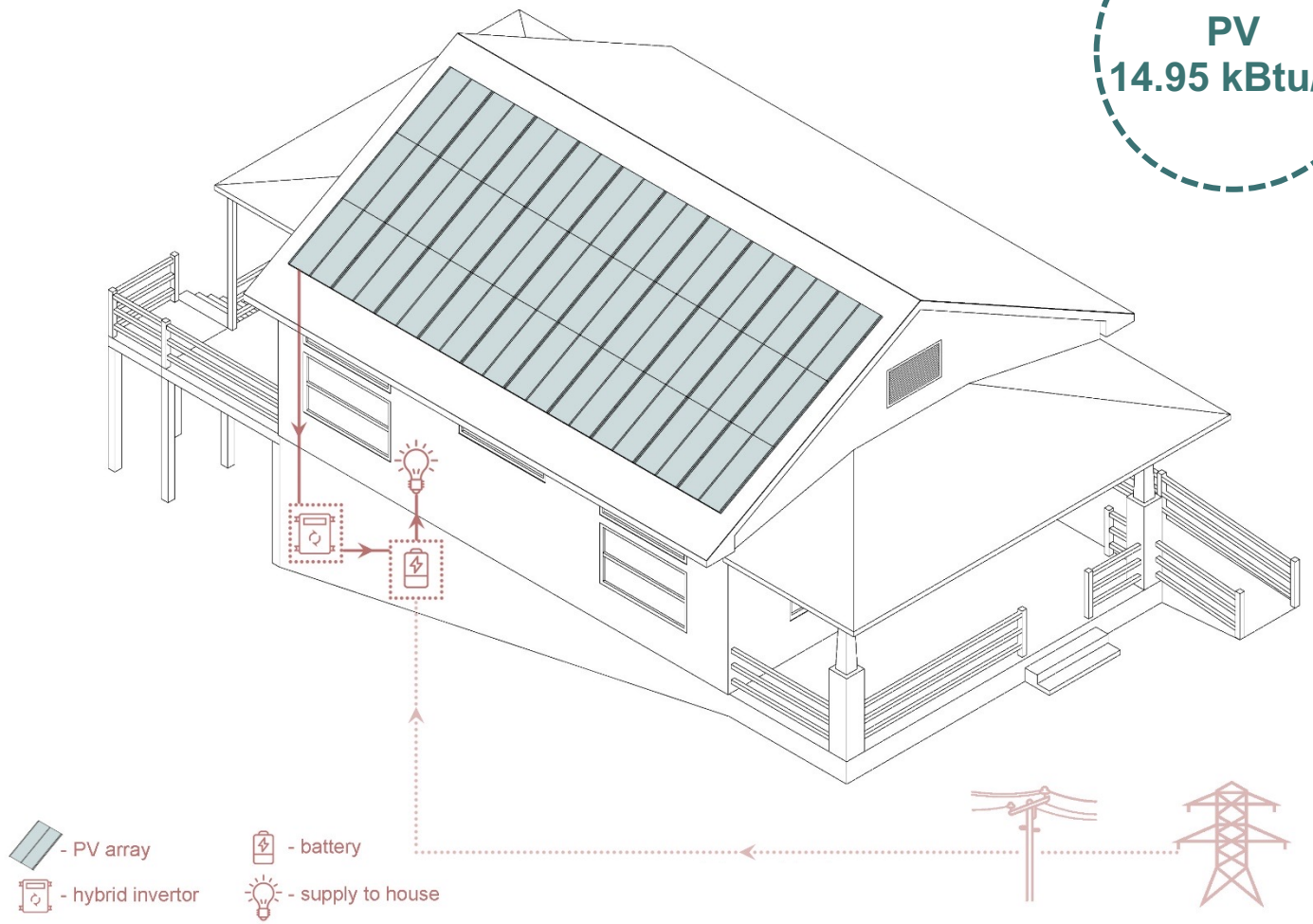
6kW Solar Power System

| Specifications | Value |
|---|---|
| Type | Monocrystalline Silicon |
| No. of Panels | 15 |
| Maximum Power per hour (W) | 400 |
| Panel Conversion Efficiency (%) | 15 |
| Panel Area (Sqft) | 22 |
| % of the Southern Roof Used for PV | 55% |
| Tilt Angle (Degrees) | 29 |

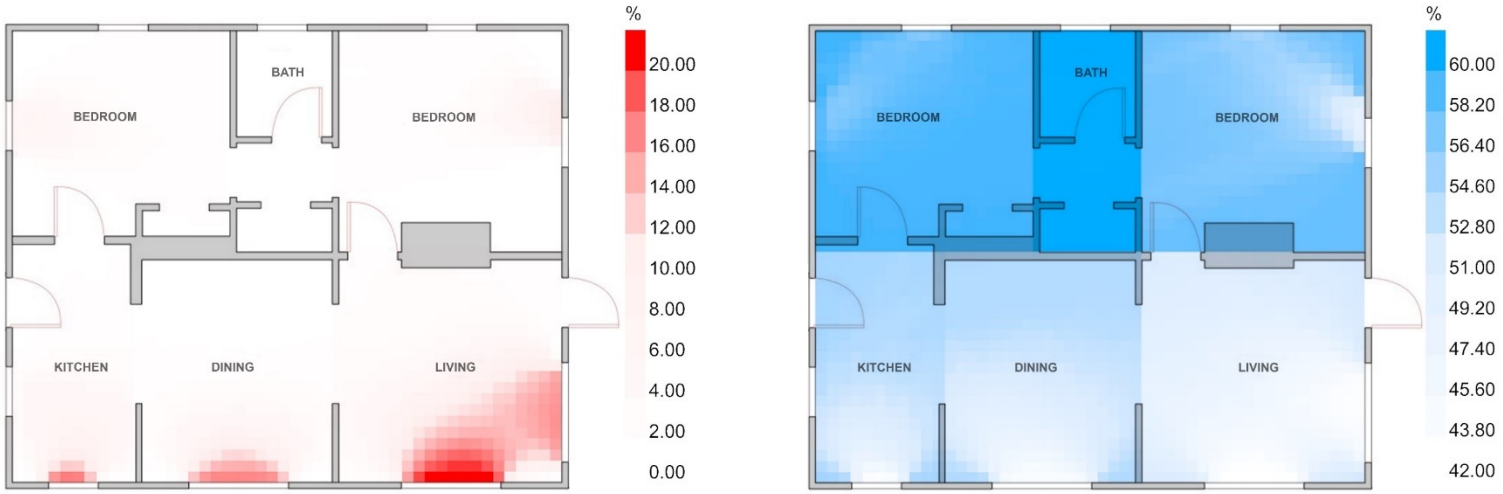
**PV Panels Specifications**

| Specifications | Value |
|---|---|
| Size (kWh) | 14.4 |
| Hybrid Inverter (kW) | 6 |
| Battery Ah | 500 |
| Nominal Voltage (V) | 48 |

**Battery Specifications**



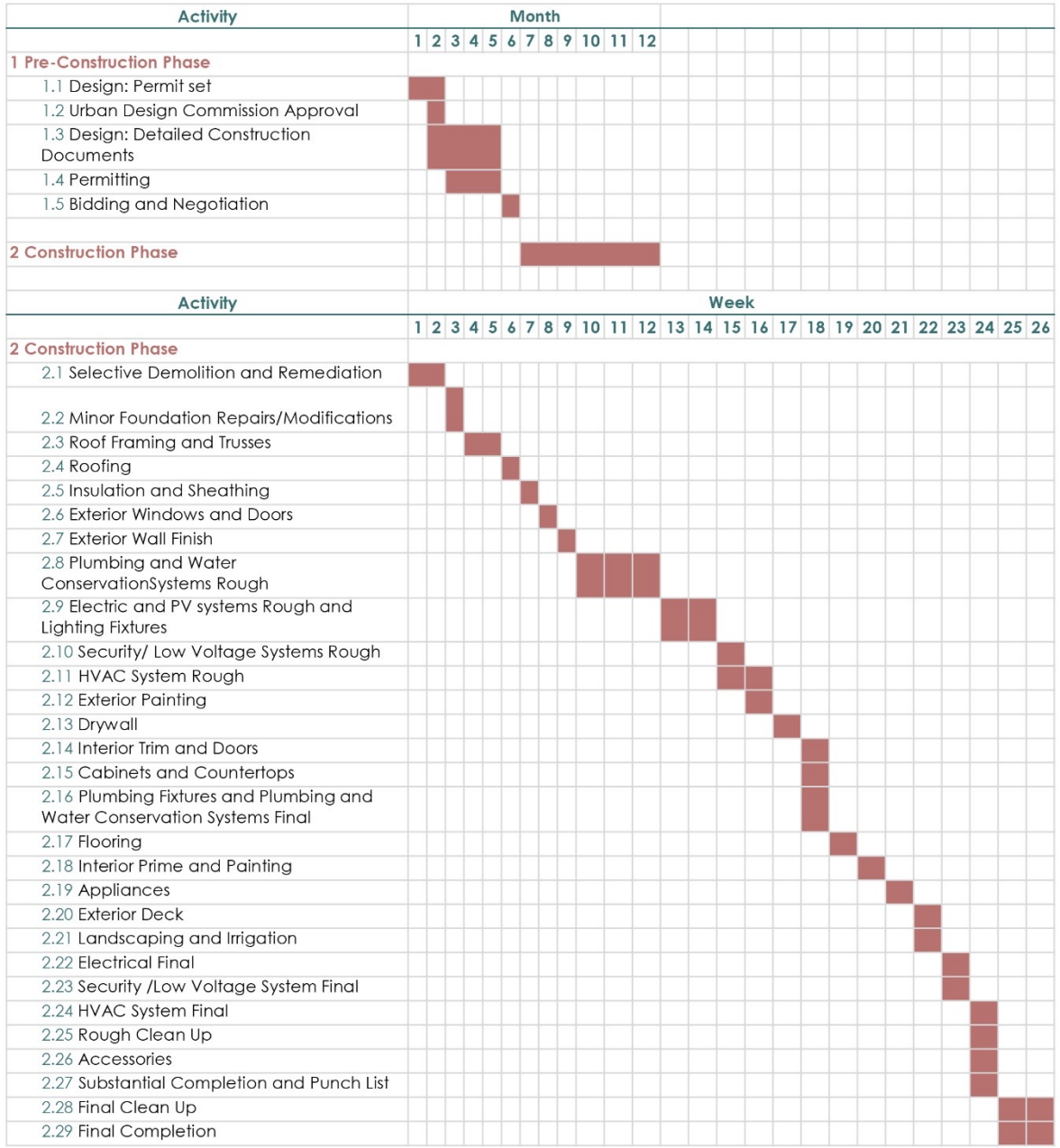
# PMV ANALYSIS




**PREDICTED MEAN VOTE (PMV) ANALYSIS – EXISTING**


**PREDICTED MEAN VOTE (PMV) ANALYSIS – 2020**

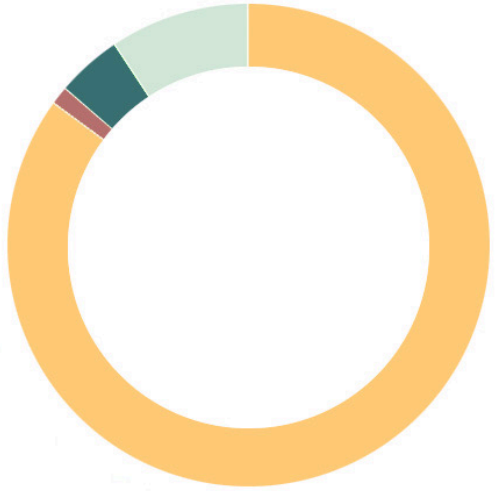
# CONSTRUCTION SCHEDULE



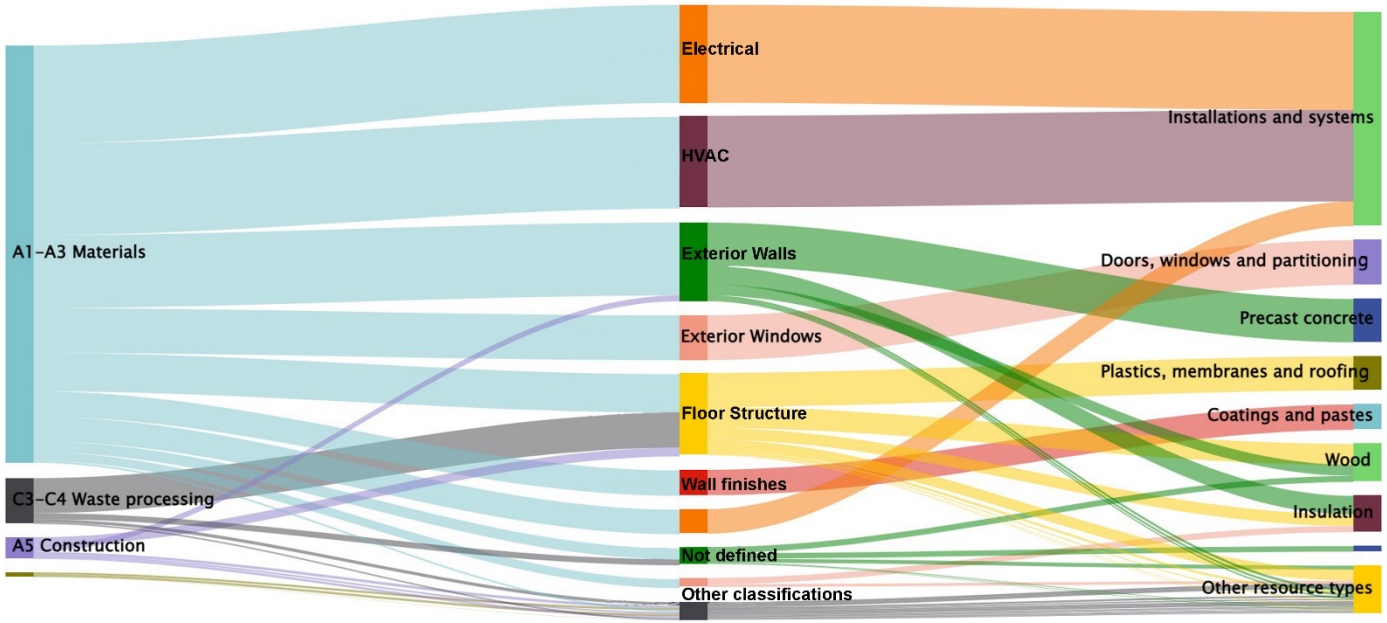
# EMBODIED CARBON

## Global warming kg CO2e - Life-cycle stages

A1-A3 Materials - 85.1%
A4 Transportation - 1.2%
A5 Construction - 4.4%
C3-C4 Waste processing - 9.3%



## Sankey diagram, Global warming



# HVAC SCHEDULE

| COMPONENT | SPECIFICATION |
|---|---|
| CONDENSER | 18 SEER, 11 HSPF, 24,000 Btuh Heat Pump based on Manual J & S |
| 5 FRESH AIR SUPPLY REGISTERS | Sized based on Manual D with total duct run of 85' and mastic |
| 4 STALE AIR RETURN GRILLES | Sized based on Manual D with total duct run of 60' and mastic |
| FORCED AIR RETURN GRILLE | Sized based on Manual D with total duct run of 10' and mastic |
| ENERGY RECOVERY VENTILATOR | Automatic humidity and temperature controls with both Intake and Exhaust Vents |
| AIR HANDLER | Energy Efficient and Centrally Located |
| CONDENSING LINE | 30' Insulated Line |
| AIR HANDLER FILTER | MERV 13 |
| UVGI BULB | 18 W, 254NM, 8.66 in, 10,000 hours |
| OVERHEAD KITCHEN HOOD EXHAUST VENT | 36", 2 Speed, 120 volts, 390 CFM, 2850 RPM |
| 3 FIVE BLADE CEILING FANS | Remote control 120 volts, 59 W, 6 Speed, 4848 CFM, Air Flow Efficiency of 78 |
| BATHROOM EXHAUST VENT | 120 volts, 17.9 W, 80 CFM, 4" Duct |
| LAUNDRY DRYER EXHAUST VENT | Passive 4" |
| LAUNDRY WASHER AIR ADMITTANCE VENT | Passive 3" |

# PLUMBING FIXTURE SCHEDULE

| PLUMBING FIXTURE SCHEDULE | | | | | |
|---|---|---|---|---|---|
| | | PIPE SIZES | | | |
| QTY | FIXTURE | C.W. | H.W. | DRAIN | REMARKS |
| 1 | FLOOR MOUNTED WATER CLOSET | 1" | -- | 3" | 1.28 GPF |
| 1 | KITCHEN SINK - 1 BASIN | 1" | 1" | 2" | 1.5 GPM |
| 1 | SINK - 24" WORK | 1/2" | 1/2" | 1 1/2" | ATCT |
| 1 | MOP SINK | 1/2" | 1/2" | 2 1/2" | |
| 1 | SHOWER- WHITE | 1/2" | 1/2" | 2" | SMOOTH WALL, BARRIER FREE, L-SHAPED GRAB BAR, 3/4 INCH SKIRT, CENTER DRAIN AND GELCOATED SURFACE. ACCEPTABLE MANUFACTURERS: AQUATIC (1363BFSD) SHOWER VALVE: PRESSURE BALANCED MIXING VALVE SHALL BE FLUSH MOUNTED WITH CONCEALED PIPING AT ADA REQUIRED HEIGHT, SINGLE LEVER HANDLE AND INTEGRAL SCREWDRIVER STOPS. SET LIMIT STOPS AT 110°F, 2.5 GPM FLOW CONTROL, WITH COMBINATION SLIDE AND GRAB BAR. ACCEPTABLE MANUFACTURERS: AQUATIC (PART OF ADA PACKAGE), DELTA, AMERICAN STANDARD, SYMMONS, SPEAKMAN, LEONARD, POWERS. SHOWER TRIM: PROVIDE WITH SOAP DISH, BRASS DRAIN AND ADA COMPLIANT SHOWER CURTAIN. PROVIDE ADA SEAT IN LEFT HAND OR RIGHT HAND CONFIGURATION AS INDICATED ON DRAWINGS. |
| 1 | SHOWER MIXING VALVE | 1/2" | 1/2" | 1 1/2" | 1.5 GPM |
| 1 | FLOOR MOUNTED WATER CLOSET - TANK | 1/2" | -- | 3" | |
| 1 | FLOOR DRAIN | 1/2" | -- | 4" | FLOOR DRAIN - DUCCO CAST IRON BODY WITH ROUND, POLISHED NICKEL-BRONZE FINISHED STRAINER, HEEL-PROOF GRATE, WITH ADJUSTABLE STRAINER HEAD. PROVIDE WITH TS-1. ACCEPTABLE MANUFACTURERS: JAY R. SMITH (2005) ZURN, WADE, OR JOSAM. |
| 1 | FLOOR DRAIN WITH CLEANOUT | 1/2" | -- | 4" | |
| 1 | SHOWER DRAIN -- | | -- | 2" | |
| 1 | FLUSH MOUNT WALL CLEANOUT -- | | -- | 3" | |
| 1 | CISTERN | 2" | 1-1/2" | 4" | 6000 Gallon Polyethylene Plastic Storage; 102" dia. x 182"H; DURA-CAST PREFERABLE |
| 1 | PRESSURE REGULATING VALVE- LEAD FREE | 1-1/2" | N/A | N/A | PROVIDE WITH PRESSURE AND TEMPERATURE GAUGES AT OUTLET. ACCEPTABLE MANUFACTURERS: WATTS (LF25AUB-Z3), ZURN, BELL AND GOSSETT |
| 1 | REDUCED PRESSURE BACKFLOW PREVENTER | 1-1/2" | N/A | N/A | REDUCED PRESSURE BACKFLOW PREVENTER - BRONZE SEATS AND STAINLESS STEEL TRIM. THE ASSEMBLY SHALL INCLUDE QUARTER TURN SHUT-OFF VALVES, TEST COCKS, AND WYE STRAINER. ACCEPTABLE MANUFACTURERS: WATTS (LF909QT). |
| 4 | TRASH PUMP | 1-1/2" | 1-1/2" | N/A | RECOMEDED USE IN GREYWATER/RAINWATER SYSTEM; ACCEPTABLE MANUFACTURERS: TSURUMI SUBMERSIBLE TRASH PUMP |
| 1 | SAND FILTER | 1-1/2" | 1-1/2" | N/A | ACCEPTABLE MANUFACTURERS: WATERWAY, BLUE WAVE, HAYWARD PRO |

Schedules

| | Occupancy Schedule | | Occupancy Schedule | | Equipment Schedule | | Lighting Schedule | |
|---|---|---|---|---|---|---|---|---|
| | Living | | Bedroom | | Entire house | | Living | Bedrooms |
| **Hours** | Weekend | Weekday | Weekend | Weekday | Weekend | Weekday | All Days | All Days |
| **0** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.06 | 0.06 |
| **1** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.06 | 0.06 |
| **2** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.06 | 0.06 |
| **3** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.06 | 0.06 |
| **4** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.19 | 0.19 |
| **5** | 0.6 | 0.5 | 1 | 1 | 0.24 | 0.24 | 0.39 | 0.39 |
| **6** | 0.7 | 0.75 | 1 | 1 | 0.24 | 0.24 | 0.44 | 0.44 |
| **7** | 0.85 | 0.75 | 1 | 1 | 0.32 | 0.33 | 0.39 | 0.39 |
| **8** | 1 | 0.9 | 0.9 | 0.8 | 0.32 | 0.32 | 0.17 | 0.17 |
| **9** | 1 | 1 | 0.6 | 0.25 | 0.35 | 0.32 | 0.12 | 0.12 |
| **10** | 0.9 | 0.9 | 0.25 | 0.15 | 0.35 | 0.32 | 0.12 | 0.12 |
| **11** | 0.7 | 0.25 | 0.25 | 0.1 | 0.4 | 0.32 | 0.12 | 0.12 |
| **12** | 0.65 | 0.25 | 0.25 | 0.1 | 0.4 | 0.32 | 0.12 | 0.12 |
| **13** | 0.65 | 0.25 | 0.51 | 0.1 | 0.4 | 0.32 | 0.12 | 0.12 |
| **14** | 0.65 | 0.25 | 0.5 | 0.1 | 0.4 | 0.32 | 0.2 | 0.2 |
| **15** | 0.65 | 0.25 | 0.25 | 0.1 | 0.4 | 0.32 | 0.12 | 0.12 |
| **16** | 0.65 | 0.25 | 0.25 | 0.1 | 0.4 | 0.32 | 0.44 | 0.36 |
| **17** | 0.8 | 0.25 | 0.26 | 0.1 | 1 | 0.94 | 0.61 | 0.4 |
| **18** | 0.8 | 0.6 | 0.26 | 0.35 | 1 | 0.92 | 0.82 | 0.61 |
| **19** | 0.8 | 1 | 0.5 | 0.7 | 1 | 0.89 | 0.98 | 0.84 |
| **20** | 0.8 | 1 | 0.7 | 0.85 | 1 | 0.89 | 1 | 1 |
| **21** | 0.8 | 1 | 0.7 | 0.85 | 1 | 0.89 | 0.69 | 0.85 |
| **22** | 0.7 | 0.7 | 1 | 1 | 0.98 | 0.89 | 0.38 | 0.45 |
| **23** | 0.6 | 0.5 | 1 | 1 | 0.23 | 0.23 | 0.16 | 0.16 |

| **Roof Assembly** | **SI** | **IP** |
|---|---|---|
| **R Value** | 0.57 | 3.22 |
| **U Value** | 1.37 | 0.24 |
| **Layers From Exterior to Interior** | **Construction** | **Thickness In Meters** |
| **High Reflective Shingles** | New | 0.02 |
| **Roof Decking** | New | 0.016 |
| **Roof Rafters** | Existing | 0.05 |

| **Floor Assembly** | **SI** | **IP** |
|---|---|---|
| **R Value** | 0.127 | 0.72 |
| **U Value** | 3.43 | 0.6 |
| **Layers From Exterior to Interior** | **Construction** | **Thickness In Meters** |
| **Wooden Boards Osb** | New | 0.016 |
| **Floor Joists** | New | 0.05 |

| | |
|---|---|
| **Requested Location:** | Atlanta |
| **Location:** | Lat, Lon: 33.73, -84.38 |
| **Lat (deg N):** | 33.73 |
| **Long (deg W):** | 84.38 |
| **Elev (m):** | 300.4 |
| **DC System Size (kW):** | 6 |
| **Module Type:** | Standard |
| **Array Type:** | Fixed (roof mount) |
| **Array Tilt (deg):** | 29 |
| **Array Azimuth (deg):** | 180 |
| **System Losses:** | 15 |
| **Invert Efficiency:** | 96 |
| **DC to AC Size Ratio:** | 1.2 |
| **Average Cost of Electricity Purchased from Utility ($/kWh):** | 0.116 |
| **Capacity Factor (%)** | 16.6 |

| Ceiling Assembly | SI | IP |
|---|---|---|
| R Value | 10 | 56.8 |
| U Value | 0.098 | 0.017 |
| **Layers From Exterior to Interior** | **Construction** | **Thickness In Meters** |
| Loose-Fill Cellulose Insulation | New | 0.38 |
| Zip Sheathing | New | 0.016 |
| Ceiling Joists | Existing | 0.05 |
| Plaster And Lath | Existing | 0.015 |
| Low VOC Paint | New | 0.01 |

| Type | U (IP) | VLT | SHGC |
|---|---|---|---|
| Double paned, Low-e window 1" | 0.27 | 0.49 | 0.21 |
| Wooden Door | 0.17 | | |

| Wall Assembly | SI | IP |
|---|---|---|
| R Value | 4.5 | 25.8 |
| U Value | 0.21 | 0.037 |
| **Layers From Exterior to Interior** | **Construction** | **Thickness In Meters** |
| Paint | New | 0.02 |
| Wood Siding Osb | Existing | 0.016 |
| Air Gap | | 0.0127 |
| Mineral Wool Board | New | 0.025 |
| Zip Sheathing | New | 0.016 |
| Cavity Cellulose Insulation | New | 0.089 |
| Std Wood 4 Inch | Existing | |
| Plaster And Lath | Existing | 0.015 |
| Low Voc Paint | New | 0.01 |

- Lighting Power Density considering LED lights in the entire house is **0.46 W/Sft**.
- The Plug Load density by considering all affordable and energy-efficient equipment is **0.62W/Sft**
- The air changes per hour is **0.35**
- As we are proposing a mini-split ducted ERV compatible heat pump system, we considered PSZ HP systems with economizer- Differential enthalpy and DCV. The Latent Heat recovery is 0.75, and the sensible heat recovery is 0.81.
- For HVAC Sizing, the peak cooling load for a summer design day is - 6019 Btu/hr
- The Peak heating load for winter design day is -3985 Btu/hr
- The setpoints are as follows:

| | Indoor | | Outdoor | |
|---|---|---|---|---|
| Set Points | Min in C/ F | Max in C/ F | Min in C/ F | Max in C / F |
| Natural Ventilation | 19 / 66.2 | 25 / 77 | 17 / 62.6 | 30 / 86 |
| HVAC | 18 / 64.4 | 26/ 78.8 | | |

- The site EUI is 12.096 kBtu/sf, and the source EUI is 40.25 kBtu/sf.
- The total energy consumed Annually for a gross area of 1991 sf is 24,070 KBtu.
- We produce 29,785 kBtu of energy on-site and achieve a Net positive house, no off-site renewable energy is used
- The EUI of the house after including PV is – 2.9 kBtu/sf

| Month | AC System Output (kWh) | AC System Output (kBtu) | Solar Radiation (kWh/m^2/day) | Plane of Array Irradiance (W/m^2) | DC array Output (kWh) | Value ($) |
|---|---|---|---|---|---|---|
| 1 | 614.4 | 2096.4 | 4.2 | 130.6 | 641.8 | 71.3 |
| 2 | 598.0 | 2040.6 | 4.6 | 128.1 | 624.9 | 69.4 |
| 3 | 758.5 | 2587.9 | 5.3 | 165.2 | 792.6 | 88.0 |
| 4 | 812.2 | 2771.4 | 6.0 | 180.2 | 848.3 | 94.2 |
| 5 | 848.9 | 2896.7 | 6.2 | 191.7 | 886.1 | 98.5 |
| 6 | 802.7 | 2739.1 | 6.2 | 186.2 | 838.3 | 93.1 |
| 7 | 786.5 | 2683.7 | 5.8 | 180.8 | 821.7 | 91.2 |
| 8 | 784.9 | 2678.2 | 5.9 | 183.6 | 819.4 | 91.1 |
| 9 | 755.8 | 2579.0 | 5.8 | 173.1 | 788.9 | 87.7 |
| 10 | 763.6 | 2605.5 | 5.5 | 171.1 | 796.7 | 88.6 |
| 11 | 644.9 | 2200.4 | 4.7 | 139.8 | 673.0 | 74.8 |
| 12 | 558.8 | 1906.7 | 3.8 | 117.9 | 583.2 | 64.8 |
| Total | 8729.3 | 29785.6 | 64.0 | 1948.5 | 9114.9 | 1012.6 |

# Home Energy Rating Certificate

Projected Report

Rating Date:
Registry ID:
Ekotrope ID: 123nRNav

## HERS® Index Score:

**44**

Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

## Annual Savings

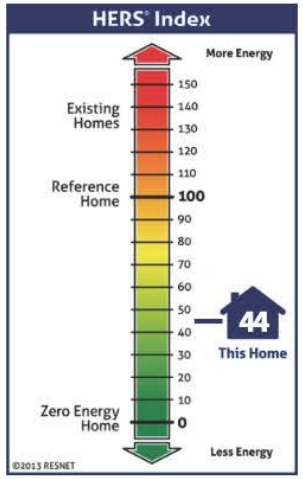
**$883**

*Relative to an average U.S. home

**Home:**
588 James P Brawley
Atlanta, GA 30318
**Builder:**

## Your Home's Estimated Energy Use:

| | Use [MBtu] | Annual Cost |
|---|---|---|
| Heating | 5.6 | $132 |
| Cooling | 1.8 | $41 |
| Hot Water | 5.6 | $130 |
| Lights/Appliances | 12.9 | $303 |
| Service Charges | | $0 |
| Generation (e.g. Solar) | 0.0 | $0 |
| **Total:** | **25.9** | **$607** |




### Home Feature Summary:

| | |
|---|---|
| Home Type: | Single family detached |
| Model: | N/A |
| Community: | N/A |
| Conditioned Floor Area: | 946 ft² |
| Number of Bedrooms: | 2 |
| Primary Heating System: | Air Source Heat Pump • Electric • 9 HSPF |
| Primary Cooling System: | Air Source Heat Pump • Electric • 18 SEER |
| Primary Water Heating: | Solar Water Heater • Electric • 1.34 Energy Factor |
| House Tightness: | 1 ACH50 |
| Ventilation: | 100 CFM • 81 Watts |
| Duct Leakage to Outside: | 0 CFM @ 25Pa (0 / 100 ft²) |
| Above Grade Walls: | R-18 |
| Ceiling: | Attic, R-57 |
| Window Type: | U-Value: 0.27, SHGC: 0.21 |
| Foundation Walls: | R-6 |
| Framed Floor: | N/A |

## This home meets or exceeds the criteria of the following:

2015 International Energy Conservation Code

## Rating Completed by:

**Energy Rater:** Samantha Morton
RESNET ID:

**Rating Company:** Georgia Tech - English Avenue Yellow Jackets

**Rating Provider:**

Samantha Morton, Certified Energy Rater
Date: 4/4/22 at 2:44 PM

# Home Energy Rating Certificate

Projected Report

Rating Date:
Registry ID:
Ekotrope ID: 123nRNav

## HERS® Index Score:

**-1**

Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

## Annual Savings

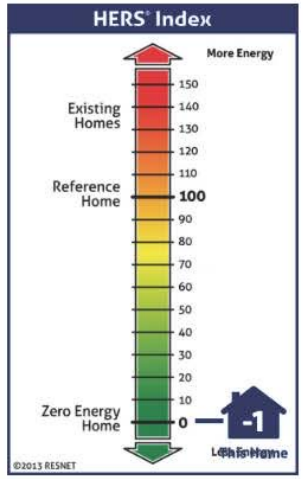
**$1,490**

*Relative to an average U.S. home

**Home:**
588 James P Brawley
Atlanta, GA 30318
**Builder:**

## Your Home's Estimated Energy Use:

| | Use [MBtu] | Annual Cost |
|---|---|---|
| Heating | 5.6 | $132 |
| Cooling | 1.8 | $41 |
| Hot Water | 5.6 | $130 |
| Lights/Appliances | 12.9 | $303 |
| Service Charges | | $0 |
| Generation (e.g. Solar) | 26.6 | -$607 |
| **Total:** | **25.9** | **$0** |




### Home Feature Summary:

| | |
|---|---|
| Home Type: | Single family detached |
| Model: | N/A |
| Community: | N/A |
| Conditioned Floor Area: | 946 ft² |
| Number of Bedrooms: | 2 |
| Primary Heating System: | Air Source Heat Pump • Electric • 9 HSPF |
| Primary Cooling System: | Air Source Heat Pump • Electric • 18 SEER |
| Primary Water Heating: | Solar Water Heater • Electric • 1.34 Energy Factor |
| House Tightness: | 1 ACH50 |
| Ventilation: | 100 CFM • 81 Watts |
| Duct Leakage to Outside: | 0 CFM @ 25Pa (0 / 100 ft²) |
| Above Grade Walls: | R-18 |
| Ceiling: | Attic, R-57 |
| Window Type: | U-Value: 0.27, SHGC: 0.21 |
| Foundation Walls: | R-6 |
| Framed Floor: | N/A |

## This home meets or exceeds the criteria of the following:

2015 International Energy Conservation Code

## Rating Completed by:

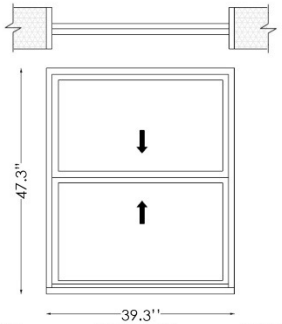
**Energy Rater:** Samantha Morton
RESNET ID:

**Rating Company:** Georgia Tech - English Avenue Yellow Jackets

**Rating Provider:**

Samantha Morton, Certified Energy Rater
Date: 4/4/22 at 2:52 PM

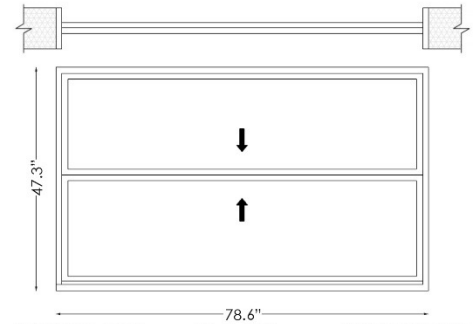
# DOOR AND WINDOW SCHEDULE




**W1**: Double hung, double pane, low-e window

39.3''x47.3"

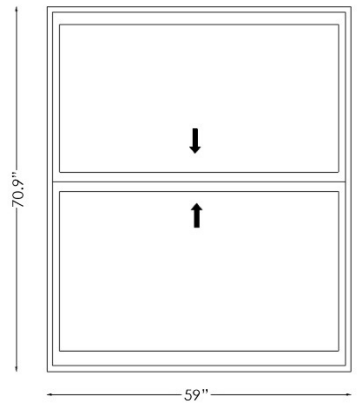
**U Value (IP)– 0.27**
**SHGC – 0.21**
**VLT – 0.49**




**W2**: Double hung, double pane, low-e window

78.6"x47.3"

**U Value (IP)– 0.27**
**SHGC – 0.21**
**VLT – 0.49**




**W3**: Double hung, double pane, low-e window

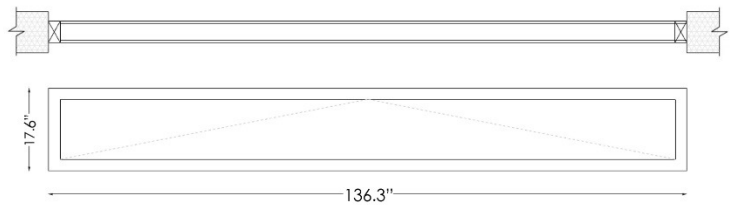
59"x70.9"

**U Value (IP)– 0.27**
**SHGC – 0.21**
**VLT – 0.49**


**W4**: Ribbon hinged window, Low E, double pane

78.6"x 17.6"

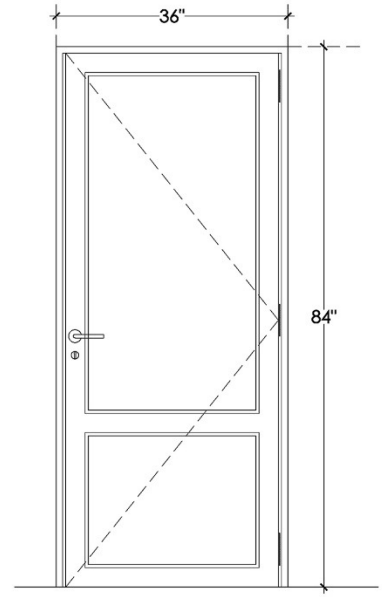
**U Value (IP)– 0.27**
**SHGC – 0.21**
**VLT – 0.49**

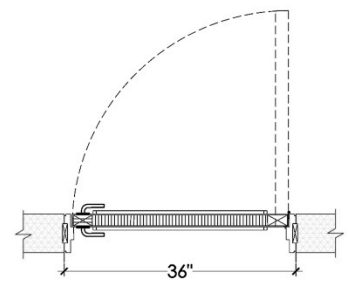



**W5**: Ribbon hinged window, Low E, double pane

136.3"x 17.6"

**U Value (IP)– 0.27**
**SHGC – 0.21**
**VLT – 0.49**




**D1:** Solid core door
**R Value: 5.88**

**WINDOW SPECIFICATIONS**

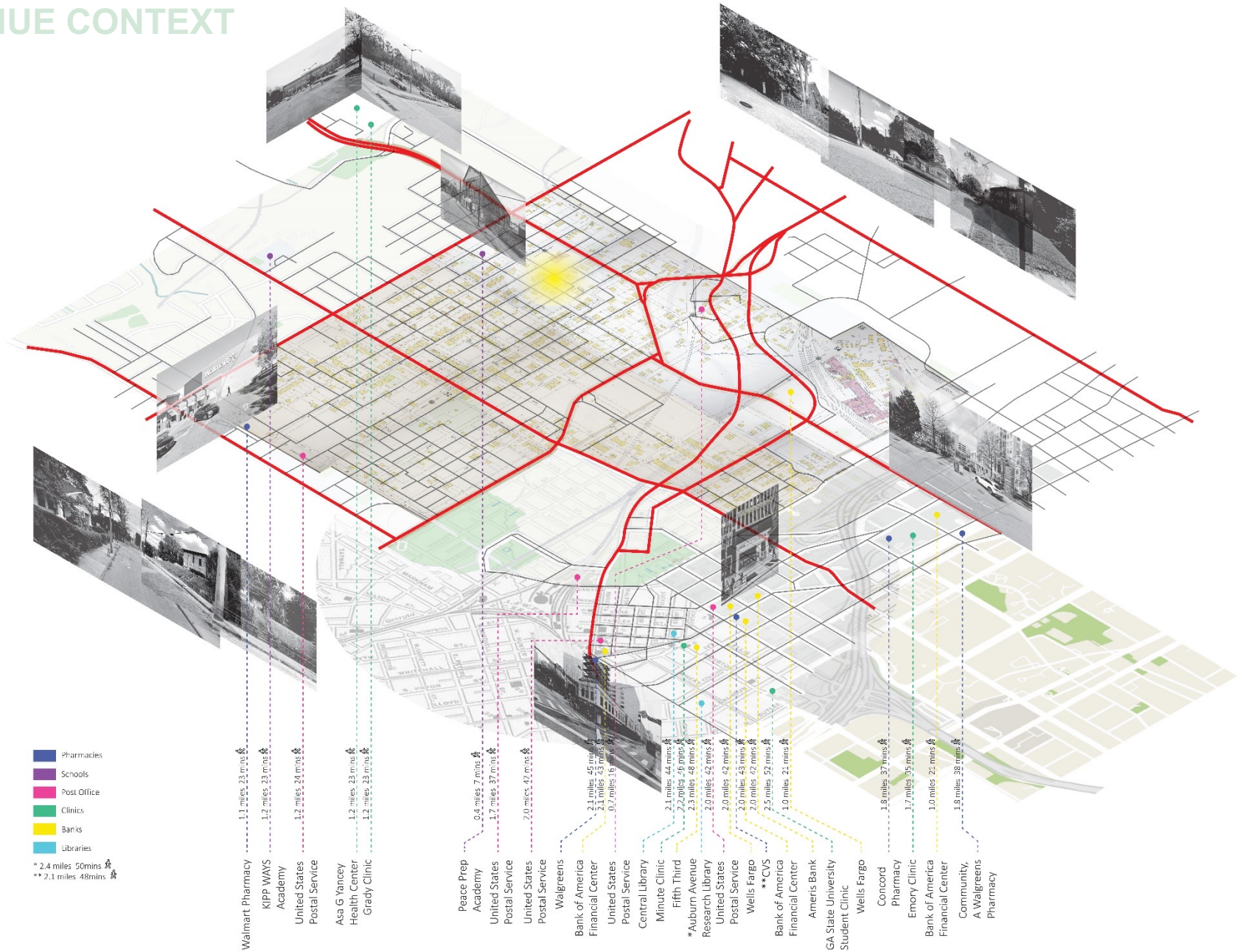
1. Construction:
- Exterior frame: Composite pre-consumer wood fibre
- Interior frame and sash: Preservative treated solid lumber(WDMA), painted finish

2. Type
- Tilt-wash double-hung full-frame
- Low-E4 with Heatlock, no grilles
- NFRC certified values
  **U Value (IP)– 0.27**
  **SHGC – 0.21**
  **VLT – 0.49**

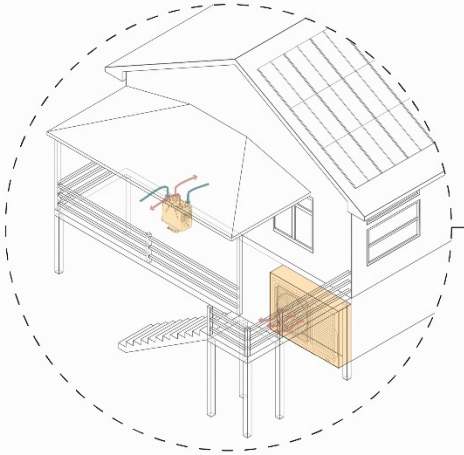
| Window type | Quantity | Height (in) | Width (in) | Placement |
|---|---|---|---|---|
| W1 - Double hung | 4 | 47.3 | 39.3 | North wall |
| W2 - Double hung | 3 | 47.3 | 78.6 | South wall |
| W3 - Double hung | 3 | 70.9 | 59 | East and west wall |
| W4 - Ribbon window | 3 | 17.6 | 78.6 | South wall |
| W5 - Ribbon window | 2 | 17.6 | 136.3 | North wall |

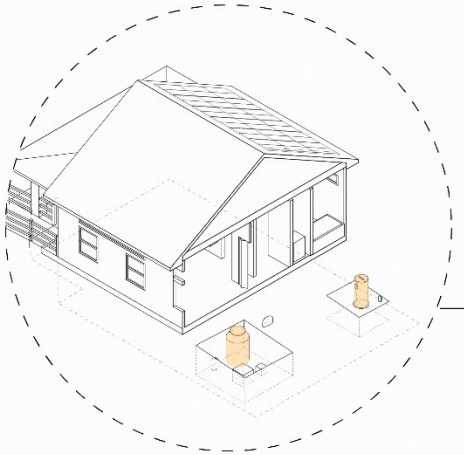
| Door type | Quantity | Height (in) | Width (in) | Placement |
|---|---|---|---|---|
| **D1**<br>*R Value: 5.88* | 5 | 84 | 36 | Main entrance, Backyard door, bedrooms and washrooms |

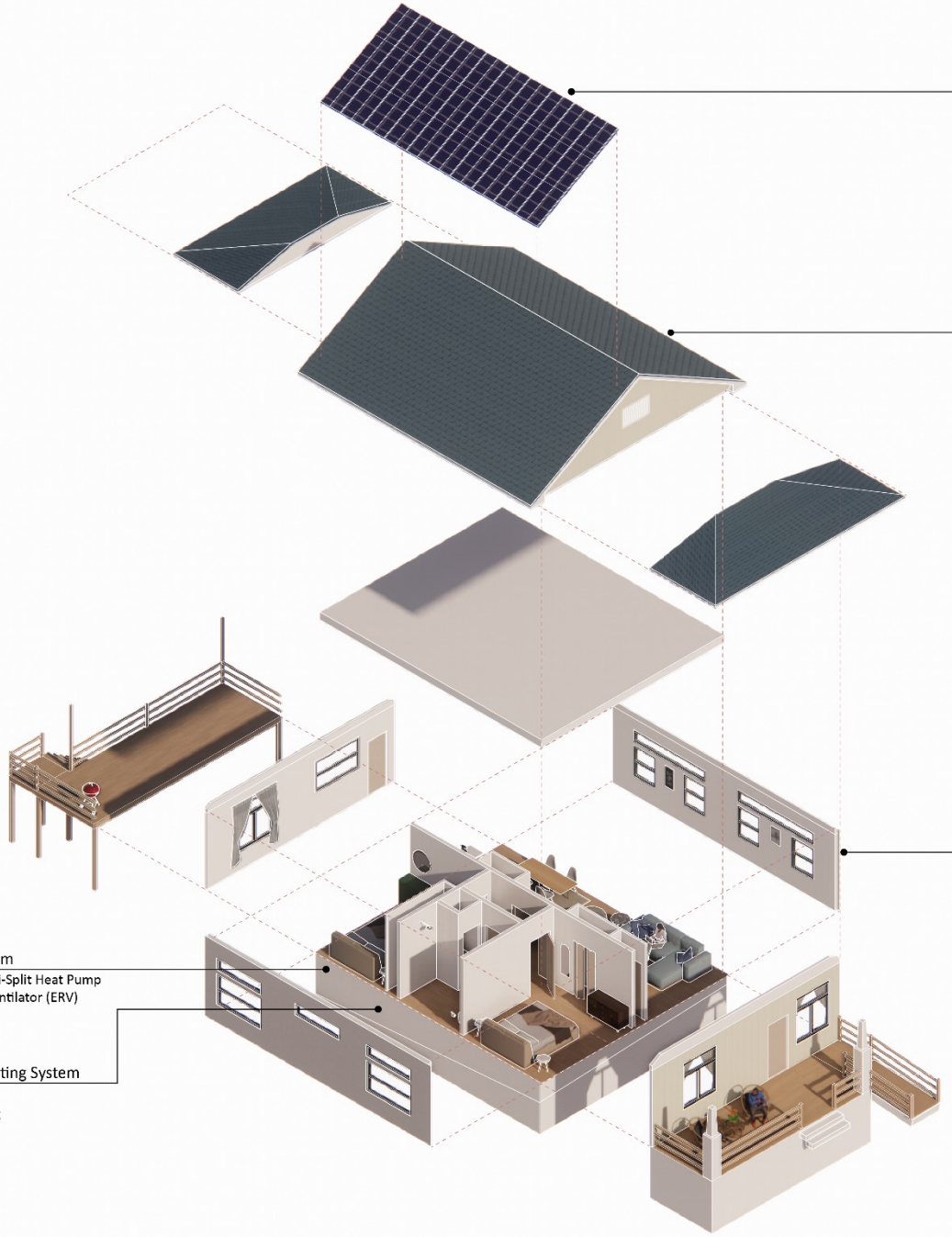
# ENGLISH AVENUE CONTEXT



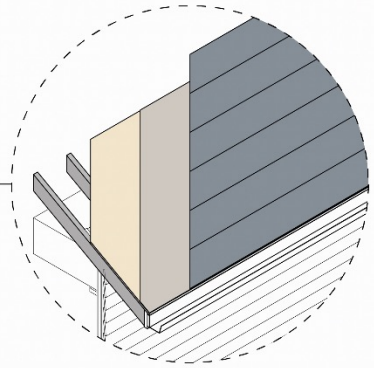
# INTEGRATED SYSTEMS



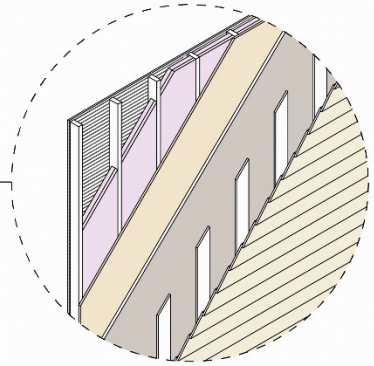




PV Panels
6 KW Photovoltaic System
14.4 KWh Lithium Battery



Roof Structure
R-Value of 60
Air Barrier Above Joists
Elimates Barrier Penetrations



Wall Structure
R-Value of 25.8
Building Envelope
Tightness 1.0 ACH 50

Mechanical System
Variable Speed Mini-Split Heat Pump
Energy Recovery Ventilator (ERV)

Rainwater Harvesting System
Subgrade Cistern
Greywater Recycling

The roof is the centerpiece of the design in which it preserves the architectural identity, protects the house from solar heat gain, protects the windows from direct sunlight, creates a volume for insulation, and provides energy through the PV system and water through the rainwater harvesting system.

East Elevation

Crawl Space

North Elevation

Roof

Roof

West Elevation